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# Requirement analysis: evaluating the degree of heterogeneity for ddDetermining an appropriate basis for contract award



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# **NAVAL POSTGRADUATE SCHOOL**

**MONTEREY, CALIFORNIA**

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## **MBA PROFESSIONAL REPORT**

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**Requirement Analysis:  
Evaluating the Degree of Heterogeneity  
for Determining an Appropriate Basis for Contract Award**

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**By: Chia-Jung Lee**

**June 2006**

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**REQUIREMENT ANALYSIS: EVALUATING THE DEGREE OF  
HETEROGENEITY FOR DETERMINING APPROPRIATE BASIS FOR  
CONTRACT AWARD**

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Submitted in partial fulfillment of the requirements for the degree of

**MASTER OF BUSINESS ADMINISTRATION**

from the

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**REQUIREMENT ANALYSIS:  
EVALUATING THE DEGREE OF HETEROGENEITY  
FOR DETERMINING AN APPROPRIATE BASIS FOR CONTRACT  
AWARD**

**ABSTRACT**

The Ministry of National Defense, MND, of the Republic of China (Taiwan) Government commonly utilizes the Lowest Tender and the Most Advantageous Tender approach in contract award procedures. Depending on the degree of heterogeneity of the requirement, either the Lowest Tender or the Most Advantageous Tender approach could be used. However, there is no procedure to determine how to evaluate the degree of heterogeneity of the requirement.

This MBA project will research how to evaluate the degree of heterogeneity of the requirements in order to determine the most appropriate basis for contract award. The research will identify the criteria used to evaluate the degree of heterogeneity of the requirements. The result of this research will be a developed model for the Contracting Officer (CO) or Program Officer (PO) to use in evaluating the heterogeneous degree of requirement. Then, based on the result of the model, the PO and CO will know which is an appropriate basis for contract award. This research will support the Taiwan Ministry of National Defense CO and PO in deciding on a requirement strategy to produce a well-designed procurement program and to get a best-value product.



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## LIST OF ACRONYMS AND ABBREVIATIONS

BV	Best Value
CPA	Construction and Planning Agency of Ministry of Interior, the Republic of China (Taiwan) government
DCS	direct commercial sales
DoD	Department of Defense of the U.S. government
FAR	Federal Acquisition Regulations in the U.S. government
FMS	foreign military sales
GPA	Government Procurement Agreement among WTO
GPL	Government Procurement Law in R.O.C. (Taiwan)
GPS	global positioning system
IG	inspector general
IPT	Integrated Product Team
IT	information technology
LPTA	Lowest Price Technically Acceptable
MND	Ministry of National Defense of the Republic of China (Taiwan) government
MOE	Taiwan Ministry of Education of the Republic of China (Taiwan) government
MPR	Military Procurement Regulations in the MND of the R.O.C. (Taiwan) government
NPS	Naval Postgraduate School
R.O.C.	Republic of China (Taiwan)
$\bar{x}$	sample mean
$x_i$	observation
$s^2$	sample variance
$s$	sample standard deviation
$s_{IT}^2$	sample variance of IT services contract

$s_{IT}$	sample standard deviation of IT services contract
$s_{IT}^2$	modified sample variance of IT services contract
$s_{IT}^*$	modified sample standard deviation of IT services contract
$s_C^2$	sample variance of custodial services contract
$s_C$	sample standard deviation of custodial services contract
$s_C^2$	modified sample variance of custodial services contract
$s_C^*$	modified sample standard deviation of custodial services contract

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## **EXECUTIVE SUMMARY**

This research is to identify the characteristics of heterogeneity of the requirement to determine an appropriate basis for contract award.

This research identifies two bases of contract award in the R.O.C (Taiwan), the Lowest Tender and the Most Advantageous Tender approach. In addition, the literature review identifies the elements of criteria of heterogeneous degree such as clarity of specification, complexity, heterogeneity, differentiation, innovation, integration, risk sharing, price information and availability, and the characteristics of organization's considerations such as resources availability, conservativeness and urgency. These factors can be used to describe the heterogeneous degree of a requirement and the internal environment of organizations.

Furthermore, this research develops a model to be used to analyze the level of heterogeneous degree and the characteristics of organization's considerations in the requirement. When the survey is conducted utilizing this model, the mean of the heterogeneity factors will determine an appropriate basis for contract award.

The findings of this research indicate that this developed model will benefit the Ministry of National Defense of the Republic of China (Taiwan) to select an appropriate basis for contract award in its procurement process. Moreover, the utilization of factors of organization's considerations shows that the internal factors dampen contracting officers' and program officers' use of business judgment in developing acquisition strategy and in determining the appropriate basis for contract award.

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## **I. INTRODUCTION**

This chapter introduces the basic structure of the MBA project. From the background, objectives of the research, research questions, and definition of key terms, readers will have a general concept on the procurement process within the Ministry of National Defense's entities of the Taiwan government, and have a concept of the direction of the research methodology.

### **A. BACKGROUND**

Before the enactment of the Government Procurement Act (GPA) in the Republic of China (Taiwan), the only concern in awarding properties and services contracts was price, except for those contracts related to purchasing computers or computer related services. The construction industry was also involved in the lowest price bid method, which often resulted in inferior quality products. Although the basis of awarding construction contracts had previously been made by a 20% discount method, the lowest bid method or reasonable bid method, these kinds of methodologies always focused on pricing and did not emphasize non-pricing elements.

The GPA was enacted on May 27, 1999 by the Taiwan Government. According to article 52, the government entity awarding contracts shall follow one of the following standardized procedures: 1. the Lowest Tender under a government estimate, 2. the Lowest Tender under a budget amount, 3. the Most Advantageous Tender (best value), and 4. Multiple Award. As a result of this amendment to the original law, the Taiwan government now takes quality into account in the Lowest Tender procedure for contract award.

The Most Advantageous Tender approach of contract award shall only be applied to cases where potential providers are allowed to submit bids for construction work, property, and services with heterogeneous (degree of difference) qualities. In these cases neither the Lowest Tender under a government estimate nor the Lowest Tender under a budget amount are applicable.



Currently, more and more entities in the Taiwan government utilize the Most Advantageous Tender approach to select the most beneficial contractors. However, it is a problem for the program officer or contract officer to decide how to evaluate the degree of heterogeneity of the requirements provided by the different vendors before solicitation. There should be an appropriate basis to evaluate whether a significant level of heterogeneity exists before solicitation. Then, the members of the evaluation team could use the Most Advantageous Tender approach to select the best vendor to support the requirements of the contract. Otherwise, efforts should not be made to utilize a complicated awarding basis for a requirement from different vendors if there is no significant degree of heterogeneity, since the Most Advantageous Tender approach in contract award is very time consuming. The determination of the appropriate basis for contract award is depicted in Figure 1.

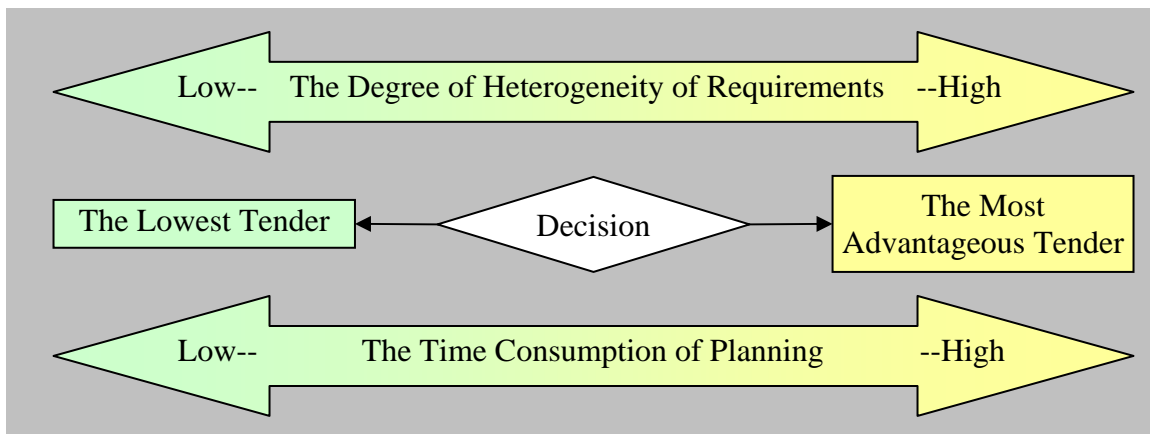


Figure 1. Flow of Appropriate Basis for Contract Award

## B. OBJECTIVES OF THE RESEARCH

The three objectives of this MBA project are as follows:

### 1. To Develop a Method for Evaluating the Degree of Heterogeneity of Requirements

What is the most appropriate basis for contract award? Evaluating the degree of heterogeneity will guide the utilization of the Lowest Tender approach or the Most Advantageous Tender approach for contract award within the Taiwan government's procurement operation.

**2. To Explore and Identify the Criteria and Elements Affecting the Evaluation of the Degree of Heterogeneity**

What are the key criteria and what are the elements of criteria that affect the evaluation of the heterogeneous degree of the requirements? How are the criteria or the elements of the criteria rated and scored?

**3. To Develop a Model Utilized in Determining an Appropriate Basis for Contract Award**

A new model will help program officers or contracting officers objectively evaluate the heterogeneous degree of requirements in order to decide whether to use the Lowest Tender approach or the Most Advantageous Tender approach in the contract award process.

**C. RESEARCH QUESTIONS**

The primary research questions to be answered are:

What is heterogeneity and how can it be characterized?

How can the degree of heterogeneity of the requirements be evaluated?

How can the degree of heterogeneity determine an appropriate basis for contract award?

**D. RESEARCH METHODOLOGY**

The methodologies of this research is literature review on of the characteristics of heterogeneity, to develop a model used to evaluate the degree of heterogeneity of requirements and to determine an appropriate basis for contract award and then to apply this model to a real-life representative procurement situation.

The literature review includes the statutes, rules, and regulations of the Taiwan government's procurement and the U.S. federal government's structure, as well as commercial textbooks, journals, and articles of both organizations. Official sources will include Taiwan and U.S. reports, instructions, and memoranda. Background documentation will be provided from other sources located at the Taiwan National Library, Taiwan Public Construction Commission of Executive Yuan, Taiwan Ministry of National Defense, and the U.S. Department of Defense.

The literature review will provide a basis for the development of a model that will contain the criteria and elements of criteria related to heterogeneity. This model will be utilized to evaluate the degree of heterogeneity of requirements and be used to determine the appropriate basis for contract award.

Once the model has been developed, it will include a questionnaire for a realistic procurement situation to be answered by procurement officers or program officers who conduct acquisition planning to determine an appropriate basis for contract award. These answers will be analyzed in determining the degree of heterogeneity and will support in concluding what is an appropriate basis for contract award.

## **E. ORGANIZATION**

Chapter I is a broad overview of this report and presents the general roadmap of the research purpose, research questions, organization, and methodology.

Chapter II provides a general discussion and brief background of the Taiwan MND's budgeting and procurement process within the Taiwan government procurement structure. Particularly, the features, advantages, and disadvantages between the Lowest Tender and the Most Advantageous Tender approach will be addressed in this chapter. It presents the criteria, elements of criteria, and the organization's considerations as well as how they will affect program officers' or contracting officers' decisions to conduct either the Lowest Tender or the Most Advantageous Tender approach in awarding contract.

Chapter III will focus on the development of a model used to evaluate the degree of heterogeneity of requirements. This model will be based on the criteria and elements of criteria of heterogeneity discovered from literature review. It will also be used for guidance by program officers and contracting officers in determining an appropriate basis for contract award.

Chapter IV will apply the model developed in Chapter III and will describe and will analyze the data and information from this model. It will help program officers and contracting officers to make the decision to conduct appropriate contract award.

Chapter V summarizes the findings of the research, presents recommendations, and suggests issues for further research and study.

## **F. BENEFITS OF STUDY**

This project will benefit the R.O.C Taiwan Government by developing new methodology for use in preparing procurement plans that will reduce manpower and time consumption.

This study may also benefit the program officers and contracting officers in the U.S. DoD if they apply this model in determining which one is an appropriate basis for contract award.

This research will also provide a body of knowledge, specifically to the area of strategies for contract award.

## **G. DEFINITION OF KEY TERMS**

The following definitions are provided to facilitate the understanding of the government procurement procedure within the Taiwan MND.

Procurement plan—Procurement plan or procurement commitment that is utilized in Taiwan MND to conduct procuring activities by each entity.<sup>1</sup>

Three channels of the procurement processes—Domestic commercial procurement (DCS) (a type of direct commercial sales), foreign commercial procurement (a type of direct commercial sales), and foreign military sales (FMS) (a type of contract between two or more governments) in Taiwan MND.<sup>2</sup>

Three phases of procurement processes—The planning phase, the contracting phase, and the contract performance phases in Taiwan MND.<sup>3</sup>

The planning phases include two steps: procurement planning and solicitation planning. Procurement planning means the process of identifying which business needs can be best met by procuring products or services outside the organization. This process involves determining whether to procure, how to procure, what to procure, how much to procure, and when to procure. Solicitation planning means the process of preparing

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<sup>1</sup> Ministry of National Defense R.O.C. Military procurement, policy. Retrieved May 22, 2006 from <http://www.mnd.gov.tw/eng/Military/default.htm>

<sup>2</sup> Ibid.

<sup>3</sup> Ibid.

the documents needed to support the solicitation. This process involves documenting program requirements and identifying potential source.<sup>4</sup>

The contracting phases include two steps: solicitation and source selection. Solicitation is the process of obtaining information (bids and proposals) from prospective sellers on how project needs can be met. Source selection is the process of receiving bids or proposals and applying evaluation criteria to select a provider.<sup>5</sup>

The contract performance phases include two steps: contract administration and contract closeout. Contract administration is the process of ensuring that each party's performance meets contractual requirements. Contract closeout is the process of verifying that all administrative matters are concluded on a contract that is otherwise physically complete. This involves completing and setting the contract, including resolving any open items.<sup>6</sup>

Requirement—The need or demand for personnel, equipment, facilities, other resources, or services by specified quantities for specific periods of time or at a specified time,<sup>7</sup> also referred to as “the subject of a procurement” in GPA.

Heterogeneity—Consisting of parts or things that are very different from each other; <sup>8</sup> the degree of difference; the requirement with high difference is considered high degree of heterogeneity.

“The procurement of heterogeneous construction works, properties or services ..... means that where a procurement contract is carried out by different suppliers, it can result in discrepancies in technology, quality, function, efficiency or the implementation of commercial terms, etc.”<sup>9</sup>

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<sup>4</sup> Garrett, G. A., & Rendon, R. G. (2005). *Contract management: Organizational Assessment Tools*. (p. 55 Table 3-3). Mclean, VA: National Contract Management Association.

<sup>5</sup> Ibid.

<sup>6</sup> Ibid.

<sup>7</sup> Defense Acquisition University. *DAU glossary of defense acquisition acronyms and terms*. Retrieved May 22, 2006 from <http://akss.dau.mil/jsp/Glossary.jsp>

<sup>8</sup> Cambridge Dictionaries Online. Retrieved May 22, 2006 from <http://dictionary.cambridge.org/define.asp?key=36878&dict=CALD>

<sup>9</sup> Regulations for Evaluation of the Most Advantageous Tender, Article 2, Paragraph 2, (2003). Retrieved May 25, 2006, from <http://www.pcc.gov.tw/eng/indexE.htm>

Lowest tender—“Where a government estimate is set for the procurement, a tenderer whose tender meets the requirements set forth in the tender documentation and is the lowest tender within the government estimate shall be awarded”;<sup>10</sup> “or where no government estimate is set for the procurement, a tenderer whose tender not only meets the requirements set forth in the tender documentation with a reasonable price, but also is the lowest tender within the budget amount shall be the winning tenderer”;<sup>11</sup> also known as the Lowest Price Technically Acceptable approach in the U.S. federal government procurement.

Lowest price technically acceptable is the award that will be made to the vendor whose price is lowest among all proposals that were deemed to be technically acceptable.<sup>12</sup>

The Most Advantageous Tender—“Where the tenderer whose tender meets the requirements set forth in the tender documentation and is the most advantageous one shall be the winning tenderer,”<sup>13</sup> also known as the Best Value approach in the U.S. federal government procurement.

Best value is the most advantageous tradeoff between price and performance for the government. Best value is determined through a process that compares strengths, weaknesses, risk, price, and performance, in accordance with selection criteria, to select the most advantageous value to the government.<sup>14</sup>

## **H. SUMMARY**

This chapter began the research on requirement analysis—evaluating the degree of heterogeneity for determining an appropriate basis for contract award. It discussed the

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<sup>10</sup> Government Procurement Act, Article 52, Paragraph 1, Subparagraph 1, (1998). Retrieved May 22, 2006, from <http://www.pcc.gov.tw/eng/indexE.htm>

<sup>11</sup> Government Procurement Act, Article 52, Paragraph 1, Subparagraph 2, (1998). Retrieved May 22, 2006, from <http://www.pcc.gov.tw/eng/indexE.htm>

<sup>12</sup> Proposal Evaluation Guide, 3 (2006). Retrieved May 22, 2006, from [http://tricare.osd.mil/tps/Eval\\_Guide.htm](http://tricare.osd.mil/tps/Eval_Guide.htm)

<sup>13</sup> Government Procurement Act, Article 52, Paragraph 1, Subparagraph 3, (1998). Retrieved May 22, 2006, from <http://www.pcc.gov.tw/eng/indexE.htm>

<sup>14</sup> Defense Acquisition University. *DAU glossary of defense acquisition acronyms and terms*. Retrieved May 22, 2006 from <http://akss.dau.mil/jsp/Glossary.jsp>

background and purpose behind the research. In addition, it introduced the research questions and methodology undertaken. Finally, it provided the framework for the report format, and listed the potential benefits of this study. The literature review in the next chapter will provide a general discussion and brief background of the Taiwan MND's budgeting and procurement process within the Taiwan government procurement structure. Particularly, the features, advantages, and disadvantages between the Lowest Tender and the Most Advantageous Tender approaches will be addressed in this chapter. The chapter presents the criteria, elements of criteria, and heterogeneity considerations as well as how they will affect program officers' or contracting officers' decisions to conduct either the Lowest Tender or the Most Advantageous Tender as an appropriate basis for contract award.

## **II. LITERATURE REVIEW**

This chapter introduces the concepts and flow of procedures in budgeting, appropriation, and procurement under the MND in the R.O.C. Taiwan government. It also discusses the process of procurement planning, the bases for contract award and the determination of the most appropriate basis for contract award, either the Lowest Tender or the Most Advantageous Tender approach.

### **A. THE BUDGETING PROCEDURE AND APPROPRIATIONS UNDER THE MND OF THE R.O.C. TAIWAN GOVERNMENT**

The following illustrate the funding procedure, appropriations, and procurement procedure within the Taiwan MND.

#### **1. The Budgeting Procedure**

The funding procedure begins with operational requirements that result from the assessments of (i) military strength and armament goals, (ii) requirements and priorities, (iii) threats, and (iv) operational concepts. Then there is the need to perform system analysis, have an outline plan, work plan, budget deliberation, and procurement plan. Documents generated by these steps should be separately approved by the responsible committees, authorities, and Legislative Yuan. It takes at most 24 months to fund the budget.





Figure 2. Flow of Budget Procedure<sup>15</sup>

## 2. The Appropriation Procedure

The appropriation under the Ministry of National Defense of the R.O.C. Taiwan government (the Taiwan MND) is divided into three portions: the investment budget, O&M budget, and the personnel maintenance budget. Among these budgets, the budget deliberation process involves the funding procedure which, lasts for 8 months and takes the longest amount of time. Other processes take less time.

## 3. The Procurement Procedure

After the Budget Deliberation is submitted to Executive Yuan by MND, each acquisition entity should prepare and submit procurement plans to get approval in soliciting. “Procurements of a value reaching the threshold are processed by the Procurement Center, Armaments Bureau, Ministry of National Defense (MND).

<sup>15</sup> Ministry of National Defense R.O.C. *Military procurement, military procurement process*. Retrieved May 22, 2006 from <http://www.mnd.gov.tw/eng/Military/Process.htm>

Otherwise, the armed services will be authorized to process the procurement. The threshold is established by the MND.”<sup>16</sup>

## **B. THE PROCUREMENT UNDER THE GPA AND MPR WITHIN THE TAIWAN MND**

The following illustrate the procurement planning, awarding, and administration processes within the MND system.

### **1. Procedure of Planning Phase**

The Government Procurement Law (GPA) does not address planning phase (including procurement planning and solicitation planning) in depth,<sup>17</sup> since the planning procedure does not directly involve the tendering procedure. However, the plan should meet the basic requirements of the tendering procedures. For example, the GPA emphasizes the general principles such as the terms of procurement, the governed entities and grantees, the determination of procurement personnel, the terms of the supplier, the responsible entity and superior entity, and prohibition activities. Procedure of Planning Phase

The MND establishes the well-organized Military Procurement Regulations (MPR) for each service to comply with preparing a procurement plan covered by the general principles, the basic requirement for the terms and conditions of the procurement plan, the plan’s organization (structure), and amendment processing.<sup>18</sup> These rules and regulations help program officers prepare a structured procurement plan and help procurement officers determine whether the plan has complied with the regulations.

The acquisition entity must develop the procurement plan at least three months prior to the beginning of each new fiscal year. The planning process includes market research, budget utilization, acquisition quantity and deployment determination, procurement channel selection, subject’s function and technical determination, trade-off

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<sup>16</sup> Ministry of National Defense R.O.C. *Military procurement, policy*. Retrieved May 22, 2006 from <http://www.mnd.gov.tw/eng/Military/default.htm>

<sup>17</sup> Ho, C. H. (2004). “A study of fuzzy analytic hierarchy process to the military procurement performance evaluation.” (Master's Thesis, Shih-Hsin University), 85-86.

<sup>18</sup> Military Procurement Regulations, 2 (2003). Retrieved May 27, 2006, from <http://law.mnd.gov.tw/Scripts/Query1B.asp?no=1A0113020032>

considerations, tendering and awarding approach determination, terms and conditions, and ceiling price estimation and analysis.<sup>19</sup>

The acquisition entity must develop the procurement plan at least three months prior to the beginning of each new fiscal year. The approving entity, such as the Procurement Center of the Armament Bureau of MND, must review this plan and determine whether it can be approved. While this plan is being approved, it must be treated as a procurement commandment. The soliciting and awarding division will either publicize this procurement commandment for public competition or will invite the potential vendors to participate in the bidding process. If the procurement plan is not approved, the approving division must notify the acquisition entity to make any necessary adjustments before the final plan can be approved.

## **2. Procedure of Invitation to Tender**

The GPA addresses this procedure in depth. The MND utilizes rules and regulations to conduct an invitation to tender, also known as solicitation. These processes can be generally depicted as follows:

### ***a. Tendering Methods***

The tendering procedures for procurement include open tendering procedures, selective tendering procedures, and limited tendering procedures.<sup>20</sup> In principle, the open and selective tendering procedures are most often utilized in comparison to the limited tendering procedure.

### ***b. Tendering Issues to Consider***

A procuring entity may conduct procurement on a turn-key project and may allow joint tendering according to the requirement.

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<sup>19</sup> Ho, C. H. (2004). "A study of fuzzy analytic hierarchy process to the military procurement performance evaluation." (Master's Thesis, Shih-Hsin University), 15-16.

<sup>20</sup> Government Procurement Act, Article 18, Paragraph 1, (1998). Retrieved May 22, 2006, from <http://www.pcc.gov.tw/eng/indexE.htm>

Turn-key project means the procurement of construction work or property by consolidating the procurement of design and work, supply, installation, or maintenance within a certain period, etc. into a contract for tendering.<sup>21</sup>

Joint tendering means the activity of two or more suppliers participating jointly in tendering, executing jointly the procurement contract after being awarded, and assuming the joint and several liability thereunder, with a view to contracting for construction work or to supplying property or services.<sup>22</sup>

The tender documentation should be awarded based on the (i) specifications, (ii) budget, (iii) estimated value in closing or disclosing, (iv) time-limits of tendering, (v) supplier qualification, (vi) deposit and returning of bid bond, (vii) methods of tenders delivering, (viii) allowing alternatives, (ix) prohibit participation of political parties, (x) questions and resolutions about the content of the tender documentation, (xi) steps of opening of tenders, (xii) buying indigenous product, (xiii) qualification of foreign bidders, and (xiv) preference for the domestic supplier.

### **3. Procedure of Contract Award**

The contract award, also known as source selection, conducted by an entity shall follow the principles specified in the tender documentation. The award can be made using either the Lowest Tender approach or the Most Advantageous Tender approach. These two approaches utilized by the Taiwan government are comparable to the Lowest Price Technically Acceptable and the Best Value method utilized by the U.S. Federal Government.

In addition to the above two approaches, the GPA also enacted the Multiple Award procedure. However, some procurement scholars do not advocate this procedure as an awarding procedure because it is simply a tendering procedure. The supplier must not submit the tender for all items, but for only some of them, in this tendering procedure.

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<sup>21</sup> Government Procurement Act, Article 24, Paragraph 2, (1998). Retrieved May 22, 2006, from <http://www.pcc.gov.tw/eng/indexE.htm>

<sup>22</sup> Government Procurement Act, Article 25, Paragraph 2, (1998). Retrieved May 22, 2006, from <http://www.pcc.gov.tw/eng/indexE.htm>

In addition to the multiple ways of contract award, the tender entity should obey all laws during tender opening, tender evaluation, contract awarding, and contract signing. These procedures are (i) setting a government estimate (ceiling price), (ii) waiving government estimate (optional), (iii) qualifying tender, (iv) requesting the tenderer's clarification, (v) applying price reduction steps, (vi) allowing negotiation, (vii) applying favoritism of local suppliers, and (viii) publishing tendering and uploading awarding information.

#### **4. Procedures of Contractor Performance Administration as Well as Inspection and Acceptance**

These two procedures are also known as part of contract administration in the U.S. During contractor performance administration, the GPA fundamentally frames the required processing and legal terms, such as the essential requirements for various types of procurement contracts, the responsibility between contractor and procuring entity, public interests governed, contract assignment prohibition and penalty, contract subcontracting, construction work monitoring, and pledges.

During inspection and acceptance, the GPA constructs the required processing and legal terms, such as the qualifications and responsibilities of inspector and auditor, the specifications of record, and the requirements of acceptance.

#### **5. Procedure of Dispute Settlement and Penal Provisions**

For any dispute between an entity and a supplier arising out of the invitation to tender, the evaluation of tender, or the award of contract, a protest or complaint may be filed in accordance with the regulations, such as the deadline of protest, the responsible entity in accepting complaint, the converges of written complaint, the reviewing determination of responsible entity, mediation, and arbitration.

Penalty shall be applied to the person who causes the supplier not to tender or not to proceed with price competition and the release of procurement information.

#### **6. Supplementary Provisions**

This section covers the provisions of (i) inter-entity supply contract, (ii) e-business, (iii) the evaluation committee, (iv) the qualification of procurement personnel,

(v) green purchase, (vi) small business, (vii) disabled employees, (viii) the exception of military procurement, (ix) the exclusivity of tendering and awarding, (x) station procurement abroad, (xi) documentation administration, (xii) auditing supervision, and (xiii) ethics regulations for procurement personnel.

## 7. Three Procurement Procedures within the MND

The following three figures depict the flow of the different types of procurement procedures within the MND.



Figure 3. Flow of Foreign Military Sales Cases of Procurement Process<sup>23</sup>

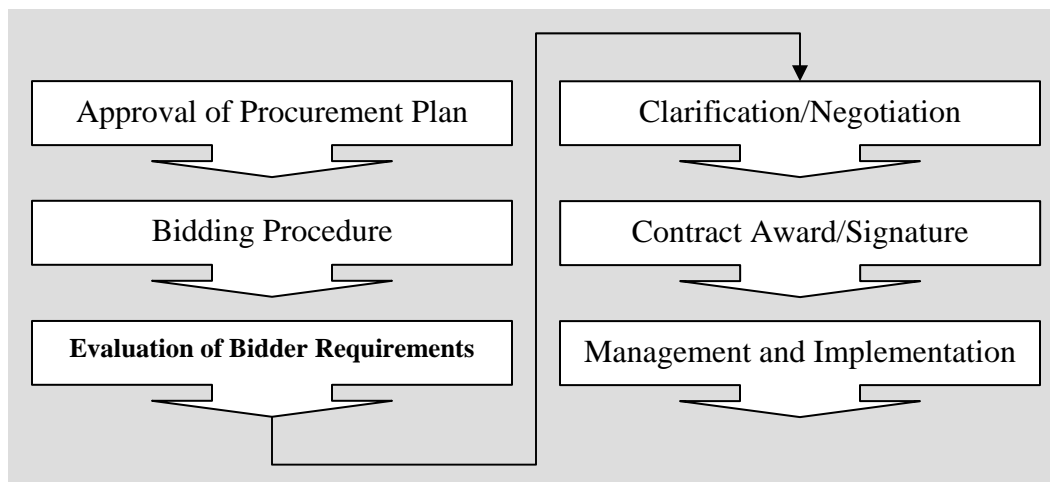


Figure 4. Flow of Direct Commercial Sales Cases of Procurement Process<sup>24</sup>

<sup>23</sup> Ministry of National Defense R.O.C. *Military procurement, policy*. Retrieved May 22, 2006 from <http://www.mnd.gov.tw/eng/Military/default.htm>

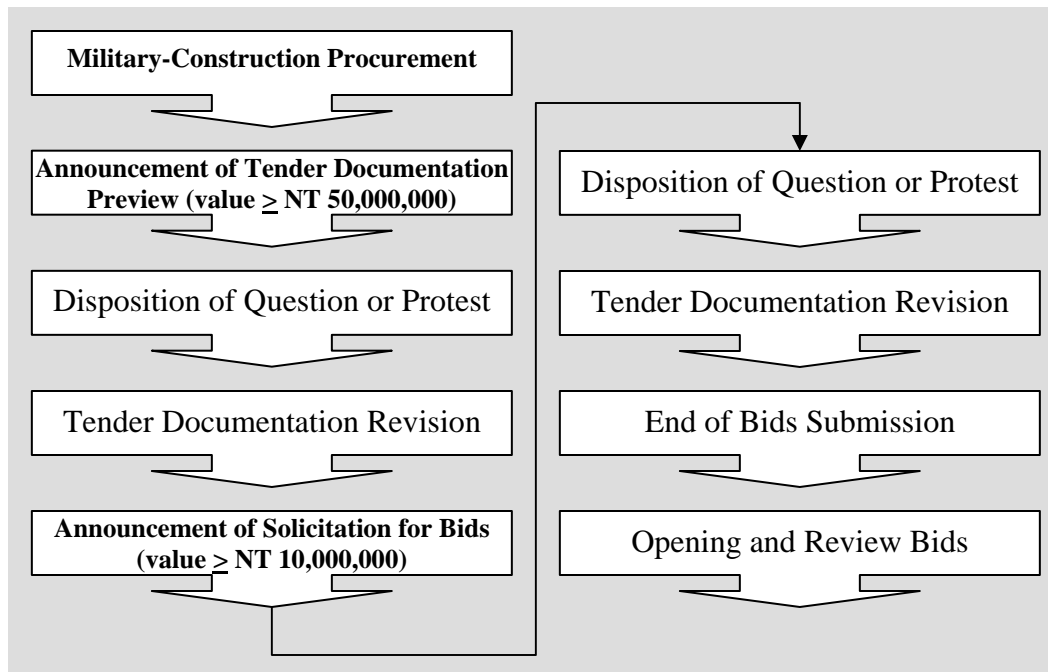


Figure 5. Flow of Military-Construction Cases of Procurement Process<sup>25</sup>

### C. THE PROCUREMENT PLANNING PROCESS

These paragraphs illustrate the process of identifying which entity's requirement can be best met by procuring products or services outside the organization. This process involves determining whether to procure, how to procure, and what to procure.<sup>26</sup>

#### 1. Whether to Procure (Channels of Procurement)

The procuring entity shall conduct a domestic procurement only if the property and/or service can be produced/provided by local suppliers.

The procuring entity shall conduct a foreign commercial procurement when local suppliers cannot provide the required property and/or service or when local suppliers cannot fulfill the requirements of the entity.

<sup>24</sup> Ministry of National Defense R.O.C. *Military procurement, policy*. Retrieved May 22, 2006 from <http://www.mnd.gov.tw/eng/Military/default.htm>.

<sup>25</sup> Ministry of National Defense R.O.C. *Military procurement, policy*. Retrieved May 22, 2006 from <http://www.mnd.gov.tw/eng/Military/default.htm>

<sup>26</sup> Garrett, G. A., & Rendon, R. G. (2005). *Contract management: Organizational Assessment Tools*. (p. 55 Table 3-3). Mclean, VA: National Contract Management Association.

The procuring entity shall conduct procurement from an international organization, a foreign government, or any of their authorized institutions in accordance with a treaty or agreement.

## **2. How to Procure: The Tendering Procedure**

The tendering procedures for procurement include open tendering procedures, selective tendering procedures, and limited tendering procedures.

### ***a. Open Tendering Procedures***

The open tendering procedures that refer to GPA mean the procedures under which a public notice is given to invite all interested suppliers to submit their tenders.

Also referred to as “public bidding,” the formal, public, and competitive procedure during which offers are requested, received, and evaluated for goods or services and after which the related contract is awarded to the bidder that complies with the conditions specified in the notice of invitation. It involves a series of stages, acts, or steps that must follow rules prescribed in the bidding documents. The procedure consists of: (i) a public invitation directed to all those with a possible interest in presenting offers; followed by (ii) an evaluation stage to select the offer most advantageous to the owner, and finally (iii) the award of the corresponding contract.<sup>27</sup>

### ***b. Selective Tendering Procedures***

The selective tendering procedures that refer to GPA mean the procedures under which a public notice is given to invite all interested suppliers to submit their qualification documents for pre-qualification evaluation based on specific qualification requirements, and after such evaluation, the qualified suppliers are invited to tender.

A method similar to open/public tendering, except that the invitations to bid are not issued to the public in general but only to firms selected by the procuring agency. In general, the same procedures are used as for competitive bidding. It may include a prequalification; this is a step in the

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<sup>27</sup> Sistema de Información al Comercio Exterior (Foreign Trade Information System). *Integrated multilingual dictionary of trade terms*. Retrieved May 22, 2006 from [http://www.sice.oas.org/dictionary/GP\\_e.asp#135](http://www.sice.oas.org/dictionary/GP_e.asp#135)



bidding process in which the agency first selects the firms to whom invitations to bid will later be issued.<sup>28</sup>

***c. Limited Tendering Procedure***

The limited tendering procedures that refer to GPA mean the procedures where no public notice is given, two or more suppliers are invited to compete, or only one supplier is invited for tendering.

Limited tendering, also known as direct contracting, means contracting with a firm that is selected without competition.<sup>29</sup>

**3. What to Procure**

The procurement that refers to GPA shall refer to the contracting of construction work, the purchase or lease of property, the retention or employment of services, etc.

In GATT language, government procurement means the process by which a government obtains the use of or acquires goods or services, or any combination thereof, for governmental purposes and not with a view to commercial sale or resale, or use in the production or supply of goods or services for commercial sale or resale.<sup>30</sup>

***a. Construction Work***

The construction work that refers to GPA means the activities performed above or underneath the ground for building, augmenting, altering, repairing, or dismantling structures and their respective auxiliary equipment/facilities, or reforming natural environment, including architectural, civil, hydraulic, environmental, transportation, mechanical, electrical, and chemical construction works and others as determined by the responsible entity.

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<sup>28</sup> Sistema de Información al Comercio Exterior (Foreign Trade Information System). *Integrated multilingual dictionary of trade terms*. Retrieved May 22, 2006 from [http://www.sice.oas.org/dictionary/GP\\_e.asp#135](http://www.sice.oas.org/dictionary/GP_e.asp#135)

<sup>29</sup> Ibid.

<sup>30</sup> Ibid.

***b. Property***

The property that refer to GPA means any and all articles (raw and fresh agricultural or fishery products excepted), materials, equipment, machines, tools, and other personal property, real property, rights, and other properties as determined by the responsible entity.

***c. Service***

The service that refer to GPA means professional services, technical services, information services, research and development, business operation management, maintenance and repair, training, labor and other services as determined by the responsible entity.

Where the content of a procurement involves construction work, property and service, or any two of them, and it is difficult to categorize the content of the procurement as construction work, property, or service, the one which takes the highest percentage of the budget of procurement shall govern the process.

**4. How to Select the Source: The Contract Award Procedure**

The award of a contract conducted by an entity shall follow one of the following principles, and the principle adopted shall be specified in the tender documentation:

***a. The Lowest Tender***

Where a government estimate is set for the procurement, a tenderer whose tender meets the requirements set forth in the tender documentation and is the lowest tender within the government estimate shall be awarded.

Where no government estimate is set for the procurement, a tenderer whose tender not only meets the requirements set forth in the tender documentation with a reasonable price, but also is the lowest tender within the budget amount, shall be the winning tenderer.

***b. The Most Advantageous Tender***

The tenderer whose tender meets the requirements set forth in the tender documentation and is the most advantageous one shall be the winning tenderer.

*c. The Adoption of Multiple Award*

The procuring entity may prescribe in the tender documentation that contracts may be awarded to different tenderers by different items or different quantities, but the spirit of competition as to the lowest price or the most advantageous tender shall be respected.<sup>31</sup>

There are only two contract award procedures within the WTO Agreement on Government Procurement, such as the Lowest Tender and the Most Advantageous Tender procedure. However, there are four contract awarding procedures within GPA, and only two are conducted in the award processing: either government estimate or budget amount setting for the procurement. These two procedures are covered under the lowest price category. Still, the Multiple Award should not be treated as a contract award approach, since it is advocated as a way to submit bids but not to evaluate the bids by some procurement scholars.

**D. THE BASIS FOR CONTRACT AWARD**

The following describes the advantages and disadvantages of awarding bases within the Lowest Tender and the Most Advantageous Tender approaches. The analysis of heterogeneity is also presented.

**1. The Lowest Tender Approach**

For the most part, price is the only consideration when awarding contracts. According to the GPA, whether or not a government estimate is set for the procurement, a tenderer whose tender meets the requirements set forth in the tender documentation and is the lowest tender within the government estimate or budget amount shall be awarded the contract. In this awarding procedure, the contracting officer first reviews the qualifications of the supplier and the specifications of the subject of a procurement. After the review, all acceptable suppliers compete on the price. The bidder with the lowest price is the winner of the contract. The advantages and disadvantages of the Lowest Tender approach as a result of literature review are described in the following table.

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<sup>31</sup> Government Procurement Act, Article 52, Paragraph 1, Subparagraph 4, (1998). Retrieved May 26, 2006, from <http://www.pcc.gov.tw/eng/indexE.htm>

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>◆ Simplifies awarding procedure; the attendees in the awarding procedure have little dispute.<sup>32</sup></li> <li>◆ Utilizes the supply that has been acquired easily or had the least disagreement among specifications from the open market.<sup>33</sup></li> <li>◆ Price is the single determination.<sup>34</sup></li> <li>◆ Saves cost and time.<sup>35</sup></li> </ul>	<ul style="list-style-type: none"> <li>◆ Ignores the non-price competition factors.<sup>36</sup></li> <li>◆ Inappropriate for the high degree of heterogeneous supply.<sup>37</sup></li> <li>◆ A product of inferior quality with the lowest price may fit into the acquisition system.<sup>38</sup></li> <li>◆ Antagonistic moods exist between supplier's and end user's position.<sup>39</sup></li> </ul>

Table 1. The Lowest Tender Analysis

## 2. The Most Advantageous Tender Approach

Generally speaking, price is not the only consideration when awarding contracts. According to the GPA, prior to conducting procurement on the basis of contract award to the most advantageous tender, an entity shall justify that (i) the subject matter of procurement concerns heterogeneous constructions works, properties, or services, (ii) and thus it is inappropriate to award the contract to the lowest tender. The procurement of heterogeneous construction works, properties, or services referred to in the preceding paragraph means that where a procurement contract is carried out by different suppliers, there can result discrepancies in technology, quality, function, efficiency, or the implementation of commercial terms. The advantages and disadvantages of the Most Advantageous Tender approach as a result of literature review are shown in the following table.

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<sup>32</sup> Wang, K. W. (2002). "The analysis study of the method and the actual experienced weight of evaluating for contract awarding policy of government procurement law." (Master's Thesis, National Defense Management College), 28.

<sup>33</sup> Li, H. C. (2004). "The study on the case and procedures of the most advantage bid on the school structure engineering." (Master's Thesis, National Central University), 10.

<sup>34</sup> Ibid.

<sup>35</sup> Ibid.

<sup>36</sup> Wang, K. W. (2002). "The analysis study of the method and the actual experienced weight of evaluating for contract awarding policy of government procurement law." (Master's Thesis, National Defense Management College), 28.

<sup>37</sup> Li, H. C. (2004). "The study on the case and procedures of the most advantage bid on the school structure engineering." (Master's Thesis, National Central University), 10.

<sup>38</sup> Ibid.

<sup>39</sup> Ibid.

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>◆ Qualitative factors, such as functions, performance, follow-on service, innovation; the acceptance between supplier and acquisition entities not only on price but also on quality and value.<sup>40</sup></li> <li>◆ The method, criteria, and weight of evaluation could be determined by a committee.<sup>41</sup></li> <li>◆ Attracting the more qualified supplier attending the competition.<sup>42</sup></li> </ul>	<ul style="list-style-type: none"> <li>◆ Ambiguous and difficult to recognize, score, and rank the degree of heterogeneity.<sup>43</sup></li> <li>◆ Lengthy organizational and evaluative process.<sup>44</sup></li> <li>◆ High complexity of determination in criteria and weight of product.<sup>45</sup></li> <li>◆ The potential for unethical procurement practice.<sup>46</sup></li> <li>◆ Time consumption in tendering document preparation, complex evaluation in scoring or ranking the supplier, resulting in possible dispute or disagreement.<sup>47</sup></li> </ul>

Table 2. The Most Advantageous Tender Analysis

## E. THE ANALYSIS OF THE CRITERIA OF HETEROGENEITY

The previous sections described two bases for contract award: the Lowest Tender and the Most Advantageous Tender approach. In deciding which approach is the most appropriate, analysis of the heterogeneity of the requirement must be conducted. “Heterogeneity” means the characteristic of the requirement provided by different vendors in terms of the following criteria extracted from literature review: technology, quality, management, and price. These criteria are directly related to the requirements themselves or the variety of the different vendors themselves.

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<sup>40</sup> Li, H. C. (2004). “The study on the case and procedures of the most advantage bid on the school structure engineering.” (Master’s Thesis, National Central University), 12.

<sup>41</sup> Wang, K. W. (2002). “The analysis study of the method and the actual experienced weight of evaluating for contract awarding policy of government procurement law.” (Master’s Thesis, National Defense Management College), 32.

<sup>42</sup> Ibid.

<sup>43</sup> Li, H. C. (2004). “The study on the case and procedures of the most advantage bid on the school structure engineering.” (Master’s Thesis, National Central University), 12.

<sup>44</sup> Ibid.

<sup>45</sup> Wang, K. W. (2002). “The analysis study of the method and the actual experienced weight of evaluating for contract awarding policy of government procurement law.” (Master’s Thesis, National Defense Management College), 33.

<sup>46</sup> Ibid.

<sup>47</sup> Ibid.

## **1. Technology**

There are two elements of criteria related to technology, which will affect the analysis of the heterogeneity of the requirement. One is the clarity of specification within solicitation planning, and the other is the level of complexity.

### ***a. The Clarity of Specification<sup>48</sup>***

If the requirement specifications are standardized and clear, such as the diameter and quantity of standardization of construction work, the weave and tension of a parachute, or the number of anesthetists and standard of work of medical service, vendors could have less opportunity to display their differentiation. If the outcome of the requirement is theoretical and conceptual, such as the ventilation and lighting of a building, thrust and horsepower of a vehicle, or the information flow per second of software, vendors could have more room to present their uniqueness and ideas.

### ***b. The Level of Complexity<sup>49</sup>***

For the requirement with little difference in pricing and quality, the procuring entity could utilize the Lowest Tender approach in source selection. Since quality has less differentiation after price competition, the procuring entity could select a vendor to provide requirements with the lowest price that is technically acceptable. However, if the requirement has highly complex technology in construction or has a guarantee of high quality, or if the quality of requirement has less differentiation after price competition, the better providers who cannot decrease the bidding price will lose their advantage and ambition in taking part in the price competition. Then, the procuring entity may select a vendor to provide a requirement with the lowest price technically acceptable but not the best valued.

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<sup>48</sup> Chou, M. H. (2004). "A study on the nature of construction industry and the heterogeneity of the built facilities." (Master's Thesis, National Central University), 68.

<sup>49</sup> Wang, K. W. (2002). "The analysis study of the method and the actual experienced weight of evaluating for contract awarding policy of government procurement law." (Master's Thesis, National Defense Management College), 92.

## **2. Quality**

There are three elements of criteria related to quality which will affect the analysis of the heterogeneity of the requirement. One is the existence of heterogeneity, another is the level of suppliers' opportunity to differentiate the quality, technicality, performance, and cost in the requirements, and the third is the innovation of how the work is to be accomplished.

### **a. *The Existence of Heterogeneity***<sup>50</sup>

The level of heterogeneity of requirements, the perceived difference in the quality of product and performance, varies from the scale of the procurement and complexity of the requirement. A small and simple construction work may be covered by a highly homogeneous degree of criteria and elements. The heterogeneous degree of criteria could be increased by a greater scale and complex characteristics. Moreover, a small and simple construction work may be covered by a highly heterogeneous degree of criteria and elements.

### **b. *The Level of Suppliers' Opportunity to Differentiate the Quality, Technicality, Performance, and Cost***<sup>51</sup>

Even for a small and simple requirement, as long as the procuring entity can set up evaluation criteria that may have suppliers display innovations, and can significantly differentiate the heterogeneous degree (quality, technicality, performance, etc.) among the suppliers, the Most Advantageous Tender approach is applied. On the other hand, if the procuring entity has set a uniform operation model or has a mandate standard, such as material specification and magnitude, the suppliers will not be able to display their innovations and differentiate their products. This situation might be suitable for utilizing the Lowest Tender approach to select a supplier.

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<sup>50</sup> Chou, M. H. (2004). "A study on the nature of construction industry and the heterogeneity of the built facilities." (Master's Thesis, National Central University), 70.

<sup>51</sup> Ibid.

*c. The Innovation of How the Work is to be Accomplished* <sup>52</sup>

According to the “Taiwan Enforcement Rules of the Government Procurement Act, Article 66,” *heterogeneity* means “the construction work, property, or services provided by different suppliers that are different in technology, quality, function, performance, characteristics, and commercial terms.” In reference to the “Taiwan Regulations for Evaluation of the Most Advantageous Tender, Article 2,” heterogeneity is defined as “the procurement of heterogeneous construction work, properties, or services that where a procurement contract is carried out by different suppliers, it can result in discrepancies in technology, quality, function, efficiency, or the implementation of commercial terms.”

Taking the construction work, for example, applying the Most Advantageous Tender approach in contract award should be based on heterogeneity after the design of construction work is completed. It can be inferred that the different vendors will provide the different products based on the heterogeneity of technology, quality, function, efficiency or the implementation of commercial terms. If the procuring entity solicits more by “what is to be done” and less on “how to do it,” the vendors can maximize their inherent niches and differentiate their innovations in order to shorten construction periods, save expenditure, or increase the efficiency of the requirements. Furthermore, these innovations resulting from different vendors will increase the degree of heterogeneity of construction work, and vendors can expend their advantages during the competition of source selection.

### **3. Management**

There are two elements of criteria related to management that will affect the analysis of the heterogeneity of the requirement. One is the integration within the prime contractor, another is the risk sharing between contractors and government.

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<sup>52</sup> Li, H. C. (2004). “The study on the case and procedures of the most advantage bid on the school structure engineering.” (Master’s Thesis, National Central University), 115.



**a.      *The Level of Integration Required Among the Parties*<sup>53</sup>**

A turn-key project affects the quality of product. The greater the hierarchy and interface among the parties, the greater the complexity of the acquisition components. The multiple hierarchy and interface within all participants lead to a heterogeneous characteristic of construction work. The integration capability and aptitude of vendors could affect the quality of construction work. This differentiates the final products among the vendors.

**b.      *The Risk Sharing Between Contractors and Government*<sup>54</sup>**

As the complexity of the requirement rises, the risk increases. This is especially true for complex research and development contracts, when performance uncertainties or the likelihood of changes makes it difficult to estimate performance costs in advance. When the risk involved is minimal or can be predicted with an acceptable degree of certainty, the fixed-price contract is preferred.

A primary function of the contract is allocating the risk of failure. This is accomplished by the type of pricing arrangements and through the terms and condition of the contract. The principal factor in determining the risk is the uncertainty associated with the technical content of the work relative to the current state-of-the-art. The greater the variance between the current state-of-the-art and the technical objectives of the contract, the greater the uncertainty of the estimated performance cost.<sup>55</sup>

**4.      Price**

There is an element of criteria related to price that will affect the analysis of the heterogeneity of the requirement. This element is the level of availability of price information.

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<sup>53</sup> Chou, M. H. (2004). "A study on the nature of construction industry and the heterogeneity of the built facilities." (Master's Thesis, National Central University), 68.

<sup>54</sup> Federal Acquisition Regulation (FAR), Part 16.103 (b), 16.104 (d) (2006). Retrieved May 22, 2006, from <http://farsite.hill.af.mil/vffara.htm>

<sup>55</sup> Engelbeck, R. M. (2004). *Acquisition Management Handbook*. (p. 126). Vienna, VA: Management Concepts.

*a. The Level of Availability of Price Information*<sup>56</sup>

Here are three market types: perfect competition market, imperfect competition market (including oligopoly and monopolistic competition markets), and the monopoly market. In a perfect competition market, pricing is crystal clear. However, pricing is controlled by the monopoly vendor. Within the imperfect competition market, the fewer the providers there are, the less clear the pricing process is. During the price competition of bidding, each provider should determine the price elements related to the criteria structure. The contracting officers or program officers can utilize these pricing structures in accordance with the tender documentation to evaluate the heterogeneity within each proposal stated.

**F. THE ORGANIZATION'S CONSIDERATIONS**

In addition to the four criteria and the related elements mentioned above, the organization's considerations should also be addressed in determining an appropriate basis for contract award. These organization's considerations should include the elements such as the influence of resources availability, the conservativeness of coordinating officials, the urgency of the delivery schedule, and the personal perspective of officials from acquisition entities and procuring entities. Compared to the analysis of the criteria of heterogeneity, the analysis of these considerations is indirectly related to the requirements themselves or the variety of the different vendors themselves. They are related to the buyers, the acquisition entities, the procuring entities, and the end users.

**1. The Influence of Resources Availability**<sup>57</sup>

The procurement entity utilizes the Most Advantageous Tender approach to select a supplier, which may depend on the cost of execution, such as the formation of the evaluation committee, preparation of invitation to tender, etc. For a small and simple construction work with a smaller degree of heterogeneity, the committee's final scoring

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<sup>56</sup> Chou, M. H. (2004). "A study on the nature of construction industry and the heterogeneity of the built facilities." (Master's Thesis, National Central University), 69.

<sup>57</sup> Chou, M. H. (2004). "A study on the nature of construction industry and the heterogeneity of the built facilities." (Master's Thesis, National Central University), 70.

will not be affected much by the selection of the supplier. In such cases, the costly Most Advantageous Tender approach should not be used for source selection.

## **2. The Conservativeness of Coordinating Officials<sup>58</sup>**

The attitude of coordinating officials such as inspector generals and comptrollers may affect the application of a contract award because they must endorse procurement plans and share the responsibility of authorization before solicitation. Some procurement entities have been accustomed to the Lowest Tender approach since this procedure is easy to operate and receives less resistance from inspectors. Moreover, disputes may come from some vendors who claim that the Most Advantageous Tender approach may benefit some particular providers, such as the tailored requirement qualification, which can fit a specific firm. Conservative surveillance officials would rather support the Lowest Tender method, which has been long used, then resolve disputes by utilizing the Most Advantageous Tender approach as a basis for a contract award.

## **3. The Urgency of the Delivery Schedule<sup>59</sup>**

When the delivery schedule is urgent, usually a well-organized vendor with a higher integrated production ability can offer a better qualified output than the less-organized one with a lower integrated production ability. If the delivery schedule is a key issue within the contract award, it should be considered and evaluated when a bidder submits a highly feasible proposal with a shorter delivery schedule.

## **4. The Perspective of Program Officers or Contracting Officers<sup>60</sup>**

Sometimes, interpretation is biased by program officers or contracting officers. The heterogeneity is meaningful only when the one who uses and receives benefit from the commodity makes one feel this item is so special that no others could be substituted. However, this is subjective. Someone may perceive a significant difference among

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<sup>58</sup> Wu, Y. F. "Multi-criteria decision aid for procurement of public construction – an example of under threshold of purchase." Unpublished Master's Thesis, National Ocean University.

<sup>59</sup> Chou, M. H. (2004). "A study on the nature of construction industry and the heterogeneity of the built facilities." (Master's Thesis, National Central University), 14.

<sup>60</sup> Chou, M. H. (2004). "A study on the nature of construction industry and the heterogeneity of the built facilities." (Master's Thesis, National Central University), 33-34.

commodities while others may not see differences since the heterogeneity among different commodities is insignificant to them.

## **G. SUMMARY**

Among the explanations of description, advantages, and disadvantages of the basis for contract award between the Lowest Tender and the Most Advantageous Tender approaches, the key heterogeneous judgments and an organization's considerations can be found in several aspects. The next chapter will utilize these aspects of analysis of heterogeneity and the organization's considerations to develop a model that will help the program officers and contracting officers to determine whether the Lowest Tender approach or the Most Advantageous Tender approach is the appropriate basis for contract award.

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### **III. MODEL DEVELOPMENT**

During the procurement process, not only should the procurement officers or program officers determine the appropriate basis for contract award, but they should also analyze the heterogeneity aspects of the requirement and the organization's consideration. The previous chapter of literature review identifies two bases for contracts award. They are the Lowest Tender method and the Most Advantageous Tender method. In determining which one is appropriate for contracts award, contracting officers (COs) and procurement officers (POs) should analyze the requirements by reviewing criteria and the twelve elements in characterizing the heterogeneity of the requirements and the organization's consideration. This chapter will develop a model in determining the appropriate basis for an awarding methodology based on related heterogeneity criteria and the organization's considerations.

#### **A. THE NEED FOR A THEORETICAL FRAMEWORK**

After defining the problem and completing the literature review, it is time to develop a theoretical framework. Uma Sekaran stated, "A theoretical framework is a conceptual model of how we theorize the relationships among the several factors that have been identified as important to the problem. This theory flows logical from the documentation of previous research in the problem area. Integrating one's logical beliefs with published research is pivotal in developing a scientific basis for the research problem."<sup>61</sup>

##### **1. Theoretical Framework**

Having examined the different kinds of variables that could operate in a situation and how the relationships among these can be established, it is now possible to see how we can develop conceptual models or theoretical frameworks for our research.

"The theoretical framework is the foundation on which the entire research project is based. It is a logically developed, described, and elaborated network of associations

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<sup>61</sup> Sekaran, U. (1984). *Research Methods for Managers: A Skill-Building Approach*. (p. 47). New York: Wiley.

among variables that have been identified through such processes as interviews, observations, and literature survey. The relationship between the literature survey and the theoretical framework is that the literature survey provides a solid basis for developing the theoretical framework. That is, the literature survey identifies the variables that might be important, as determined by previous research findings. The theoretical framework draws on these findings.”<sup>62</sup>

## **B. THE THEORETICAL FRAMEWORK DEVELOPMENT**

A theoretical framework in determining an appropriate basis for contract award will be developed in accordance with the analysis of heterogeneity and the organization’s considerations that were identified as being important in the previous literature review. The criteria related to heterogeneity analysis can be defined by four factors: technology, quality, management, and price. The characteristics related to the organization’s considerations are cost of execution, conservativeness, urgency, and perspective. These elements will determine an appropriate basis for contract award, either the Lowest Tender or the Most Advantageous Tender approaches. The content of this framework can be organized as shown in Figure 6.

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<sup>62</sup> Sekaran, U. (1984). *Research Methods for Managers: A Skill-Building Approach*. (p. 58). New York: Wiley.

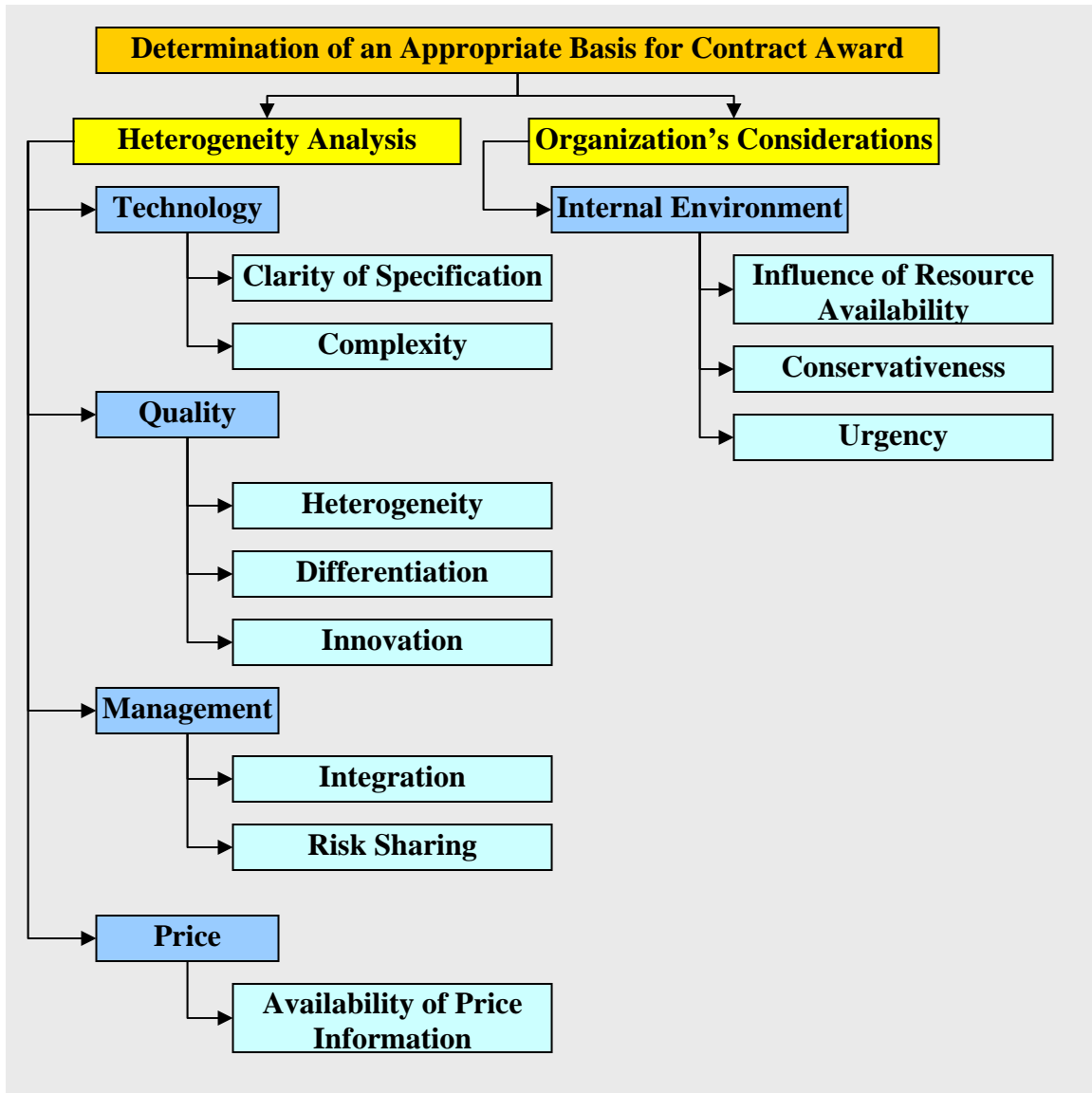


Figure 6. The Model of Determination of an Appropriate Basis for Contract Award

As long as the conceptual model related to the determination of an appropriate basis for contract award has been framed, it is necessary to theorize the relationships between each factor and the two awarding methodologies for determining an appropriate basis. The factors have been identified from literature review as the important criteria and characteristics by scholars and experts. In order to evaluate the degree of heterogeneity and the government's considerations, one must determine the magnitude of each factor



prior to the rating process. It is then necessary to score the ratings in order to calculate the final score of the selected requirement. The application of rating and scoring each factor is shown in Figure 7.

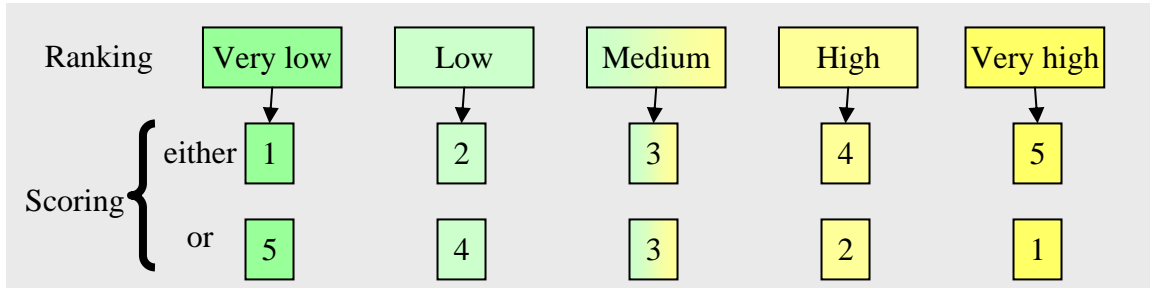


Figure 7. Determination of Rating and Scoring

Why does the rating of very low result in a scoring of either 1 or 5? Prior to analysis, it is determined that the higher the scoring, the more appropriate it is to utilize the Most Advantageous Tender approach for contract award. The direction of each factor can be based on either a positive or negative description. For example, if the rating is positive, such as the specification's clarity of the requirement, the lower the score. Furthermore, if the rating is negative, such as the complexity of the requirement, the higher the score. How is a score of 3 determined? To help interpret score determinations, each factor will be analyzed below.

### C. THE ANALYSIS OF HETEROGENEITY

From previous literature review, the heterogeneity can be analyzed using four criteria: technology, quality, management, and price. According to the degree of heterogeneity, each related element implies the decision of an appropriate basis for contract award. For computation purposes, a score from 1 to 5 will be assigned a rating from very high to very low, corresponding to each question. However, scoring must be done carefully since an incorrect score will affect the final calculation. In order to analyze and interpret these elements easily, an example of a "waste disposal service for a military hospital" on a Taiwan military hospital will be used. This example will be employed in rating and scoring the degree of heterogeneity of the requirement. The analysis is segmented as follows:

## **1. The Clarity of Specification of Requirements**

The question of this category will be: “How would you rate the level of the specification’s clarity in this requirement?”

If the specification’s clarity is very clear or the tender documentation is itemized by “how things are to be done” in extreme detail, then the rating is very high and it receives 1 point. For a rating that is “high” or not “very high,” it receives 2 points. For both of the ratings mentioned above, it can be inferred that the Lowest Tender approach will be an appropriate basis for contract award in this matter.

If the tender documentation is itemized simply by “what is to be done” and is extremely ambiguous, then the rating is very low and it receives 5 points. If the rating is “low” not “very low,” it receives 4 points. For both of the ratings mentioned above, it can be inferred that the Most Advantageous Tender approach is the better one to use.

If the rating is medium (neither high nor low), then the rating should be 3 points. This means that either the Most Advantageous Tender or the Lowest Tender approach may be a possible solution.

Using the waste disposal services example, the disposal methodology of this requirement is pretty clear and specific and is mandated under the related waste laws, so that the specification and standard of work of this requirement can be developed easily. For this kind of service, each vendor can provide very similar service compared to others. Since the “methods and facilities for storage, clearance, and disposal of industrial waste shall meet regulations designated by the central competent authority,”<sup>63</sup> the vendors can decide only the hours, workloads, and rate per pound/Kg on their proposal. Therefore, the answers related to these elements in rating the degree of clarity of specification will expected to be very high and the score should be 1 point. The determination of this element is shown in Figure 8.

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<sup>63</sup> Waste Disposal Act, Article 36, Paragraph 1, (2001). Retrieved May 23, 2006, from <http://law.epa.gov.tw/en/laws/245676169.html#art36>

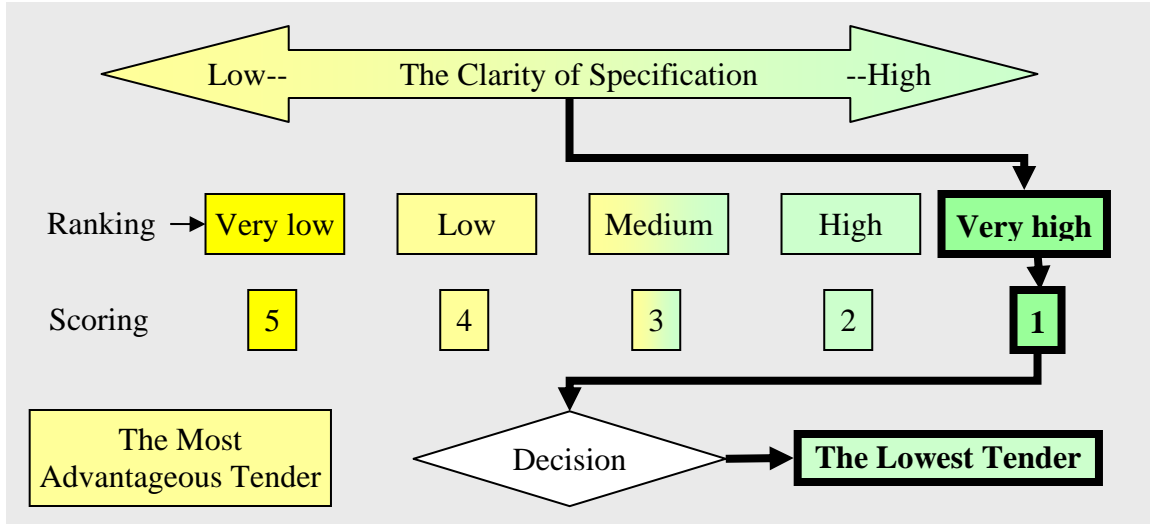


Figure 8. The Determination of Clarity of Specification of the Requirement

## 2. The Level of Complexity of the Requirement

The question of this category will be: “How would you rate the level of the complexity in this requirement?”

If a very sophisticated technology is needed for this requirement, then the rating should be very high and should receive 5 points. It can be inferred that the Most Advantageous Tender will be an appropriate basis for contract award. On the other hand, if the level of complexity or technology is simple, then the rating is very low and it receives 1 point. It can be inferred that the Lowest Tender will be a better basis for contract award. Moreover, if the level of technology is intermediate, then the rating is in the middle and should receive 3 points. It means that either the Most Advantageous Tender or the Lowest Tender approach may be used.

Using the waste disposal services example, before accepting the lowest price proposal for contract awards, it is expected that (i) the complexity of this requirement will be very low and (ii) each vendor will not utilize a very sophisticated technology to fulfill this contract. Therefore the vendors should not hire well-educational, highly experienced and personnel to provide service. For this kind of service, hospitals simply need to separate, collect, and store the waste. The degree of complexity of the technology is

expected to be very low and the score should be 1 point. The determination of this element is shown in Figure 9.

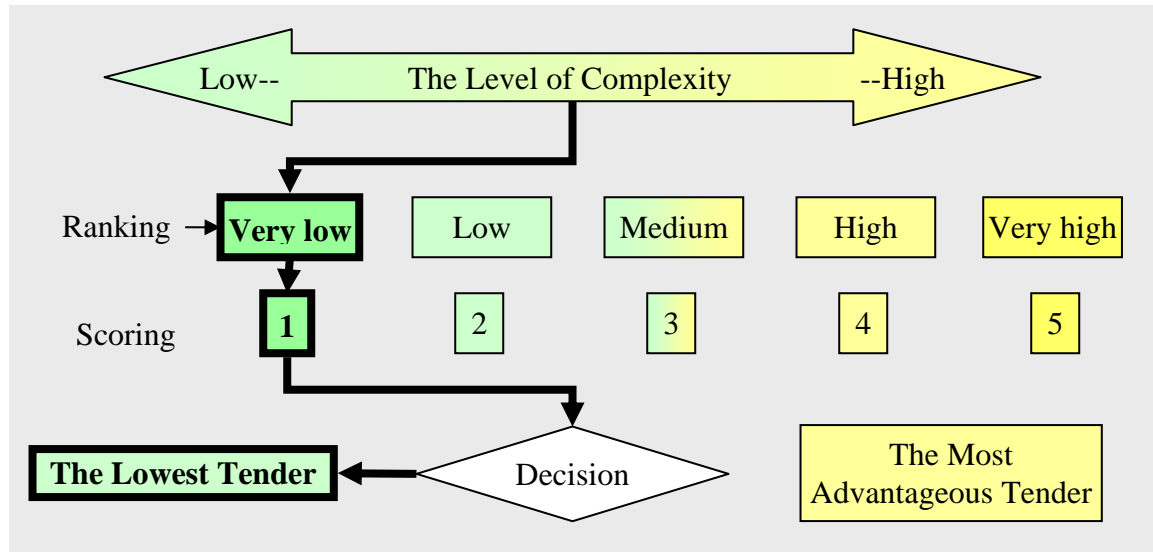


Figure 9. The Determination of Level of Complexity

### 3. The Level of Heterogeneity in the Quality of Product and Performance

The question of this category will be: “How would you rate the level of heterogeneity (perceived difference in the quality of product and performance) in this requirement?”

For example, popcorn has very low heterogeneity in quality and diamonds have very high heterogeneity in quality. If the level of heterogeneity is significant, then the rating is should be high and it receive 5 points. It can be inferred that the Most Advantageous Tender will be an appropriate basis for contract award. On the other hand, if the level of quality is very insignificant, then the rating should be very low and receive 1 point. Therefore, it can be inferred that the Lowest Tender will be a better basis to use. Moreover, if the level of quality is intermediate (neither high nor low), the rating should be in the middle and receive 3 points. This means that either the Most Advantageous Tender or the Lowest Tender approach may be used..

Exploring further the waste disposal services as an example, the requirement of the acquisition entity is that the contractor periodically cleans up the hospital waste

according to the Taiwan Waste Disposal Act. Does the hospital care about how the contractor disposes the waste (bury it, incinerate them it, etc.)? The answer is “No.” As long as the contractors meet the contract specification that is specified in the Taiwan Waste Disposal Act and related rules and regulations, the hospital does not care how the contractors perform the service as long as they meet the required specifications of the acts. These disposal methodologies are regulatory under the requirement of law. Among the various vendors that utilize different disposal methods, (waste facilities or renewable factories), the level of heterogeneity can be expected to be very low and the score should be 1 point. The determination of this element is shown in Figure 10.

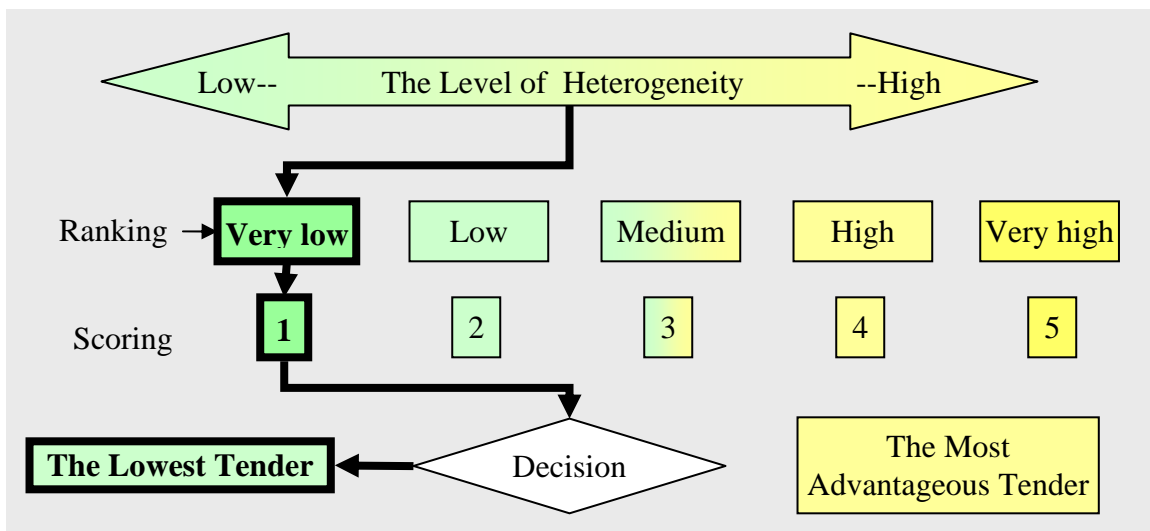


Figure 10. The Determination of Level of Heterogeneity

#### 4. The Opportunity of Suppliers to Differentiate the Quality, Technicality, Performance, and Cost for the Requirements

The question of this category will be: “How would you rate the level of suppliers’ opportunity to differentiate the quality, technicality, performance, and cost for this requirement?”

If the suppliers’ opportunity to differentiate quality, technicality, performance, and cost among various vendors is very strong, then the rating is very high and should receive 5 points. Therefore, it can be inferred that the Most Advantageous Tender will be an appropriate basis for contract award. On the other hand, if suppliers cannot

differentiate among the vendors, the rating is very low and should receive 1 point. Therefore, it can be inferred that the Lowest Tender will be a better basis to use. If the ability to differentiate is intermediate, neither strong nor weak, then the rating is somewhere in the middle and should receive 3 points. This means that either the Most Advantageous Tender or the Lowest Tender approach may be a possible solution.

Using the waste disposal services as an example, how would the contractors deliver, bury, incinerate, and retrieve the hospital waste? The method used should be in accordance with the statutes under the “Methods and Facilities Standards for the Storage, Clearance, and Disposal of Industrial Waste.” “These Standards are determined pursuant to Article 36, Paragraph 2 of the Waste Disposal Act (herein referred to as this Act).” For the transportation process, each dust cart must have well-equipped containers and must be installed with a GPS instrument so that each city and county environmental protection bureau can track the departure and arrival destination that each driver uses. For the disposal process, each disposal personnel must perform the cleaning work in reference to the law’s requirements. The opportunity of suppliers to differentiate the quality, technicality, performance, and cost for this requirement can be expected to be very low and the score should be 1 point. This process is shown in Figure 11.

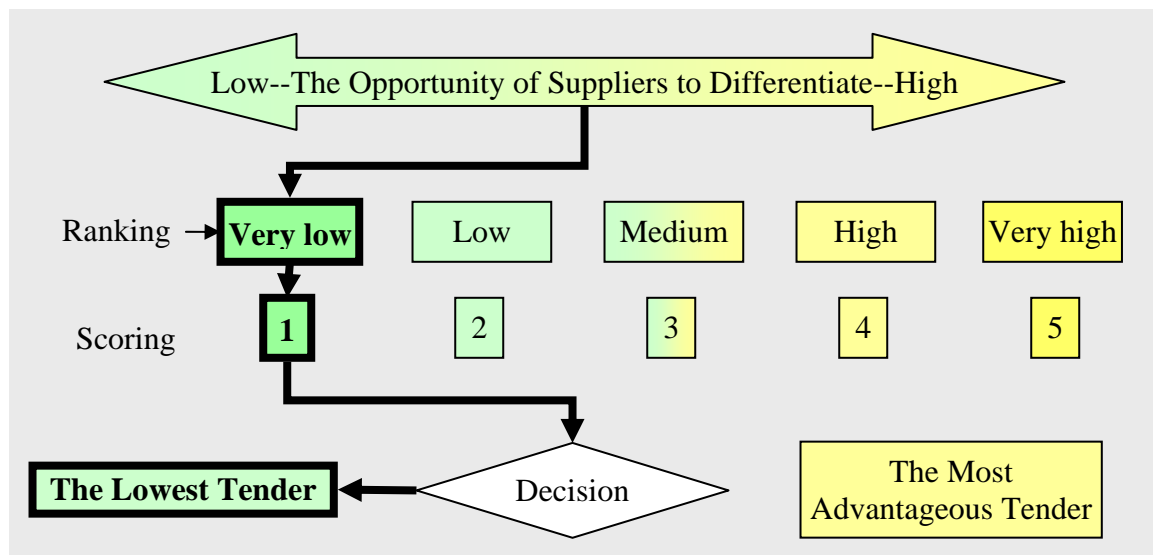


Figure 11. The Determination of Opportunity of Suppliers to Differentiate

## **5. The Level of Innovation in How the Work Is to be Accomplished**

The question of this category will be: “How would you rate the level of innovation of how the work is to be accomplished in this requirement?”

If the level of innovation of how the work is to be accomplished among different vendors is very high, then the rating is very high and should receive 5 points. Therefore, it can be inferred that the Most Advantageous Tender will be an appropriate basis for contract award. On the other hand, if the level of innovation to be used is very low, then the rating is very low and should receive 1 point. Therefore, it can be inferred that the Lowest Tender will be the better basis to use. Moreover, if the level of innovation is intermediate, then the rating is somewhere in the middle and should receive 3 points. This means that either the Most Advantageous Tender or the Lowest Tender approaches may be used.

Continuing on with the waste disposal services as an example, how will contractor perform the activities of storage and disposal of industrial waste? According to the Methods and Facilities Standards for the Storage, Clearance, and Disposal of Industrial Waste, here are the mandates: solidification, stabilization, thermal treatment, sterilization, and landfilling methods. As long as the contractors clean up the hospital waste, they must follow one of the mandated methods for disposal. In using the thermal method to dispose waste, if contractors use less time than is required and burns the waste at a lower temperature than required, or uses another dumping method not mandated under waste law, the contractors violate the commandment. This will lead contractors to either receive penalty from government or to be revoked the operation license by government. The innovation of how the work is to be accomplished among vendors can be expected to be very low and the score should be 1 point. The process is shown in Figure 12.

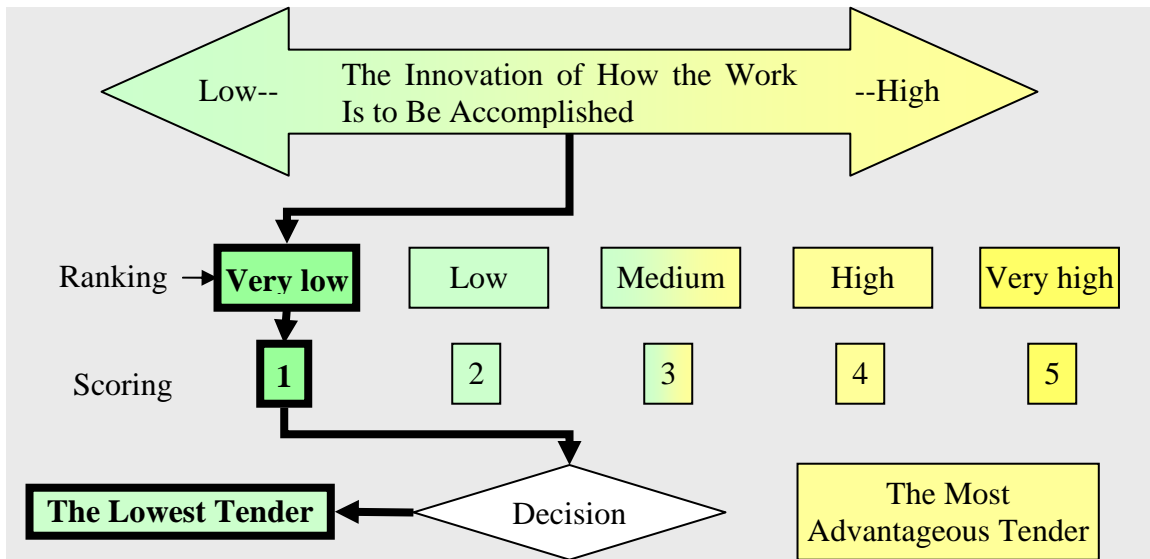


Figure 12. The Determination of the Level of Innovation in How the Work Is to be Accomplished

## 6. The Level of Integration Required Among Contracting Parties

The question of this category will be: “How would you rate the level of integration required among contracting parties in this requirement?”

If the level of required integration is very high, then the rating is very high and it should receive 5 points. Therefore, it can be inferred that the Most Advantageous Tender will be an appropriate basis for contract award. On the other hand, if the level of integration is very low, then the rating is very low should receive 1 point. Therefore, it can be inferred that the Lowest Tender will be the better basis. Moreover, if the level of integration is intermediate, then the rating should be in the middle and receive 3 points. This means that either the Most Advantageous Tender or the Lowest Tender approaches may be used.

Looking further at the waste disposal services as an example, the military hospitals are responsible only for waste storage and must outsource waste disposal. Clearance means the acts of collecting and transporting waste.<sup>64</sup> Enterprises of waste

<sup>64</sup> Methods and Facilities Standards for the Storage, Clearance and Disposal of Industrial Waste, Article 2, Paragraph 1, Subparagraph 2, (2002). Retrieved May 23, 2006, from <http://law.epa.gov.tw/en/laws/315755978.html#art02>



disposal should submit validated documentation with an agreement from clearance enterprises within the tendering procedure.<sup>65</sup>

Disposal means the acts of intermediate treatment, final disposal, and reuse of waste.<sup>66</sup> Clearance enterprises of waste disposal should apply the joint tendering procedure with disposal enterprises within the tendering procedure.<sup>67</sup>

For this kind of service, procurement entities must recognize the relationship of the suppliers, either the clearance enterprises or disposal enterprises, and must review the tendering document and related operation license. Since the integration of this requirement is somewhat low, the answer related to this element in rating the degree of integration required will expected to be low with a score of 2 points. This is depicted in Figure 13.

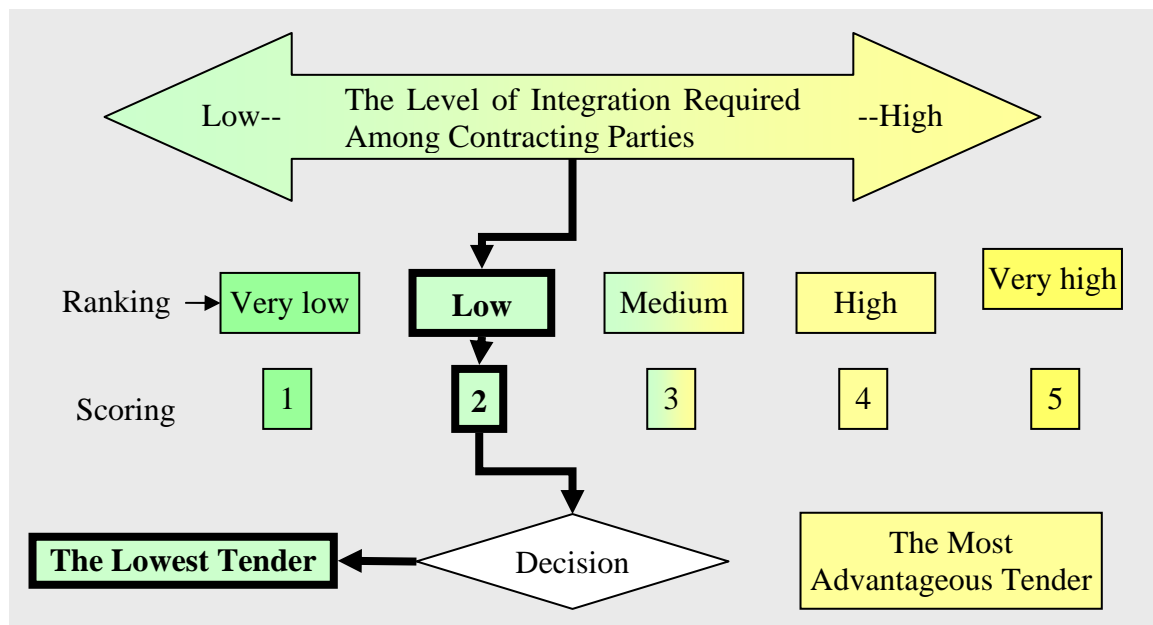


Figure 13. The Determination of the Integration Required Among Contracting Parties

<sup>65</sup> Kaoshiung Military Hospital. (2004). Remarks of Suppliers Qualification, NB94002P, Procurement Plan of Waste Disposal Services.

<sup>66</sup> Methods and Facilities Standards for the Storage, Clearance and Disposal of Industrial Waste, Article 2, Paragraph 1, Subparagraph 3, (2002). Retrieved May 23, 2006, from <http://law.epa.gov.tw/en/laws/315755978.html#art02>

<sup>67</sup> Waste Disposal Act, Article 36, Paragraph 1, (2001). Retrieved May 23, 2006, from <http://law.epa.gov.tw/en/laws/245676169.html#art36>

## **7. The Level of Risk Sharing Between Contractors and Government**

The question of this category will be: “How would you rate the level of risk sharing between contractors and government in this requirement?”

If the level of risk sharing is very high, then the rating is very high and should receive 5 points. Therefore, it can be inferred that the Most Advantageous Tender will be an appropriate basis for contract award at this matter. On the other hand, if the level of risk sharing is very low, then the rating is very low and should receive 1 point. Therefore, it can be inferred that the Lowest Tender approach will be the better one to use. If the level of risk sharing is moderate, then the rating should be in the middle and receive 3 points. this means that either the Most Advantageous Tender or the Lowest Tender approaches may be a possible solution.

Exploring the waste disposal services further, the principal factor in determining the risk is the uncertainty associated with the technical content of the work relative to what is currently state-of-the-art. Since the technologies of waste disposal are statutory under the Waste Disposal Act and related statutes, such as for solidification, stabilization, thermal treatment, sterilization, and landfilling methods, and the uncertainty associated with technical content of the requirement is pretty low, the level of risk sharing will expect to be very low. For this kind of service, procurement entities need only to collect, deliver, and dispose the hospital waste.

Because of the nature of waste and the application of disposal technology under mandated waste statutes, hospitals need to periodically separate and store the waste in a container. Contractors must dispose of the waste in accordance to the laws. So the degree of risk sharing between contractors and government can be anticipated to be very low and the score should be 1 point. This is shown in Figure 14.

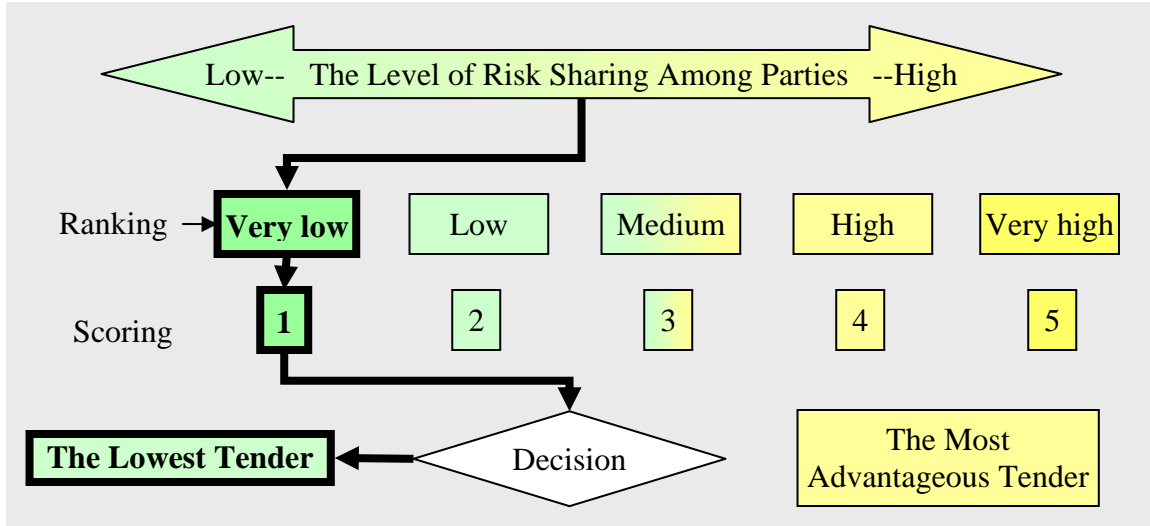


Figure 14. The Determination of Risk Sharing Between Parties

## 8. The Availability of Price Information

The question of this category will be: “How would you rate the level of availability of price information in this requirement?”

If price information is extremely easy to obtain, then the rating is very high and it should receive 1 point. Therefore, it can be inferred that the Lowest Tender will be an appropriate approach for contract award. On the other hand, if the price information is difficult to obtain, then the rating is very low and should receive 5 points. Therefore, it can be inferred that the Most Advantageous Tender will be the better one to use. If the price information is neither extremely difficult or easy to obtain, then the rating is in the middle and should receive 3 points. This means that either the Most Advantageous Tender or the Lowest Tender approaches may be a used.

Using the waste disposal services as an example once again, the number of waste enterprises must depend on the waste production in each political district in Taiwan. Each waste enterprise must establish its operation facility at the registered district and must not provide disposal waste service across different cities and counties. It is anticipated that the number of waste enterprises must be less than the number of dining enterprises. However, the number of waste enterprises must be more than the number of computer chip enterprises, since the latter must have larger capital to establish its production

facility than the other enterprises do. Furthermore, comparing to the amount of business's information available, the information of waste disposal enterprises may be at the middle position of information available within dining, waste disposal and computer chip production.

Since the availability of price information in this requirement is neither very high nor very low, the rating related to this element in determining the rating will be in the middle. For this kind of service, each vendor occupies its own territory, and vendors within each district and can provide very similar service when compared to each other. The determination of the availability of price information is shown in Figure 15.

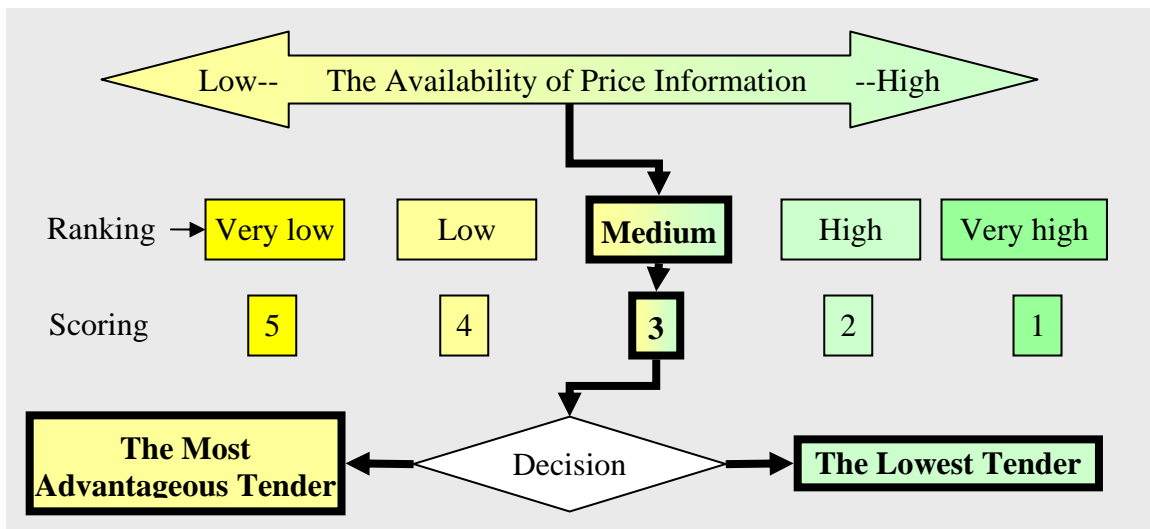


Figure 15. The Determination of Availability of Price Information

#### D. ANALYSIS OF THE ORGANIZATION'S CONSIDERATIONS

From previous literature review, the characteristics related to the organization's considerations can be defined as the influence of resource availability, conservativeness, and urgency. According to the degree of a government's considerations, each related factor implies the appropriate basis for contract award. For computation purposes, a score from 1 to 5 will be assigned a rating between very high and very low, which corresponds to each question. However, scoring must be carefully done since an incorrect score will

affect the final calculation. In order to analyze and interpret these elements easily, the previous example of waste management will be used. The analysis is categorized as follows:

### **1. The Influence of Resources Availability**

The question of this category will be: “How would you rate the level of influence of resources availability in this requirement?”

If the influence of resources availability in this project or entity is extremely inadequate, then the rating is very high and receives 1 point. Therefore, it can be inferred that the Lowest Tender will be an appropriate basis for contract award. On the other hand, if the influence of resources availability in this project or entity is sufficient, then the rating is very low and receives 5 points. Therefore, it can be inferred that the Most Advantageous Tender will be the better one to use. If the influence is moderate, then the rating is in the middle and should receive 3 points. This means that either the Most Advantageous Tender or the Lowest Tender approach may be a possible solution.

Because most Taiwan military hospitals must rely on supplementary from MND to cover the deficit for their operation, and military hospitals have high expenditures such as doctors’ and nurses’ salaries, hospitals don’t have a large budget for hiring or organizing the evaluation board to assess which vendor is the best for disposal of hospital waste. The influence of resources availability in this project or entity is extremely inadequate, then the rating related to this category is expected to be very high and the score should be 1 point. This is depicted in Figure 16.

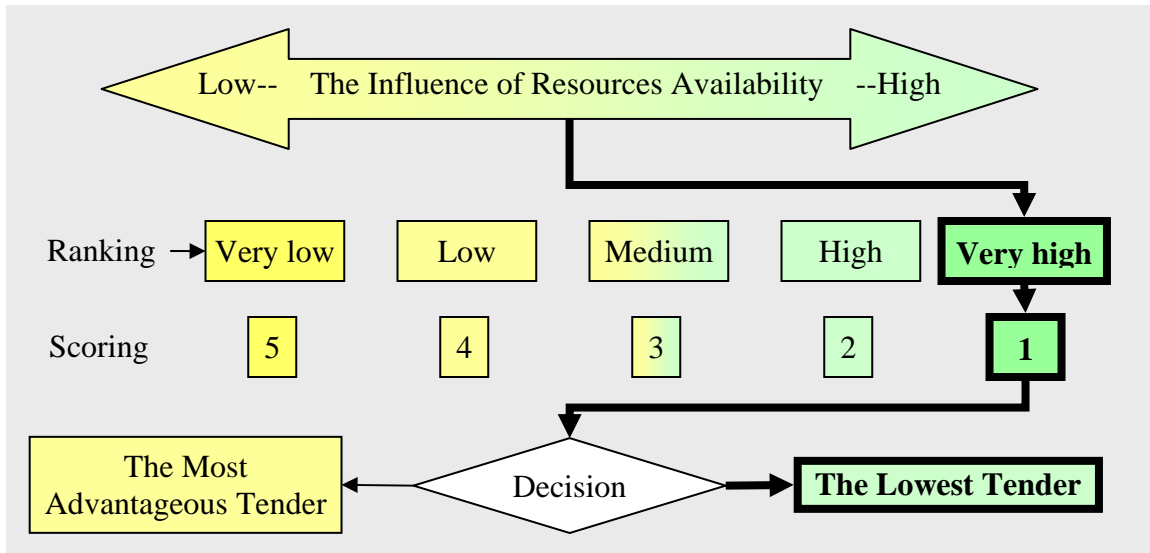


Figure 16. The Determination of Influence of Resources Availability

## 2. The Conservativeness of Coordinating Officials

The question of this category will be: “How would you rate the level of conservativeness of coordinating officials (such as inspector generals and comptrollers) within acquisition and procuring entities? As a member of the Integrated Product Team (IPT), how do you think the potential oversight from the inspector general will be a consideration in this requirement?”

The conservativeness of coordinating officials can be generally evaluated by their workload and their responsibility and familiarity with this process. If the level of conservativeness of coordinating officials is very strong, then the rating is very high and should receive 1 point. Therefore, the Lowest Tender will be an appropriate basis for contract award. On the other hand, if the conservativeness is very low, then the rating is very low and should receive 5 points. Therefore, it can be inferred that the Most Advantageous Tender will be the better one to use. If the level of conservativeness is moderate, then the rating is in the middle and should receive 3 points. This means that either the Most Advantageous Tender or the Lowest Tender approach may be a possible solution.

Since coordinating officials defend the bottom line in taking responsibility for budget surveillance, they tend to be more “traditional.” Within an environment with a

workforce shortage, it can be assumed that the coordinating official must endorse many procurement plans and share much of the responsibility of authorization before soliciting. There has been no waste disposal contract awarded using the Most Advantageous approach in the history of awarding these contracts by military hospitals. Therefore the rating related to conservativeness is high and the score should be 2 points. This is shown in Figure 17.

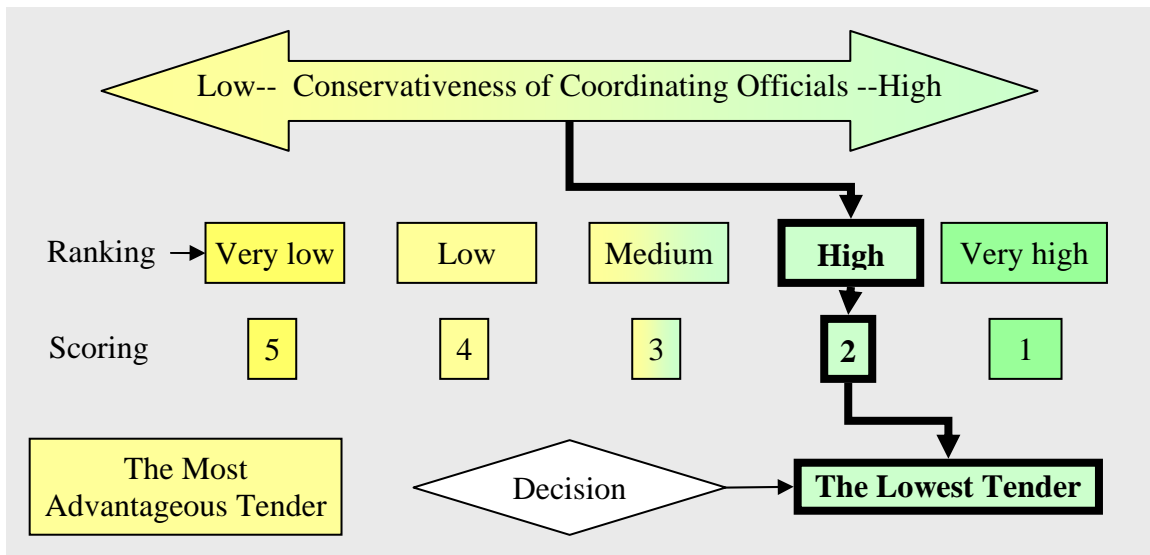


Figure 17. The Determination of Conservativeness of Coordinating Officials

### 3. The Urgency of the Delivery Schedule

The question of this category will be: “How would you rate the level of urgency of the delivery schedule in this project?”

When the urgency of this project is extreme, generally speaking, the program officers and contracting officers do not have sufficient time to do market research and receive little information in developing tender documentation. Furthermore, they depend on the proposal for solutions to schedule requirements and to set reasonable pricing for cost savings. In this example, urgency is very high, and the rating is very high, receiving a score of 5 points. Therefore, it can be inferred that the Most Advantageous Tender will be an appropriate basis for contract award. However, if the urgency is low, then the rating is very low and receives 1 point. It can be inferred that the Lowest Tender will be the better one to use. If the urgency is moderate, the rating should be in the middle and

receive 3 points. This means that either the Most Advantageous Tender or the Lowest Tender approach may be a possible solution.

On September 21, 1999, Taiwan experienced a catastrophic earthquake with many fatalities. Within the badly stricken area, more than one hundred thousand families became homeless and two thousand residents died instantly. Several reconstruction projects were initiated immediately. One of the most successful projects was campus reconstruction. The Taiwan Ministry of Education, MOE, and the Construction and Planning Agency of Ministry of Interior, CPA, cooperated and utilized the Most Advantageous Tender approach for contract award. The students' safety and their return to school were the most important factors, and utilizing the Most Advantageous Tender approach of contract award to reconstruct the campus in a short period resulted in a satisfactory quality of buildings. Compared to other plans, this project was the most successful, with a 90% degree level of satisfaction.

Using the waste disposal services as an example, the procurement plans must be developed by each entity within three months of the upcoming year and the usual performance period is either one or two years. Each military hospital has sufficient working time for planning, soliciting, and awarding waste disposal contract. The contractor's need to dispose of waste daily. The rating related to the delivery schedule is very low and the score should be 1 point. This is depicted in Figure 18.

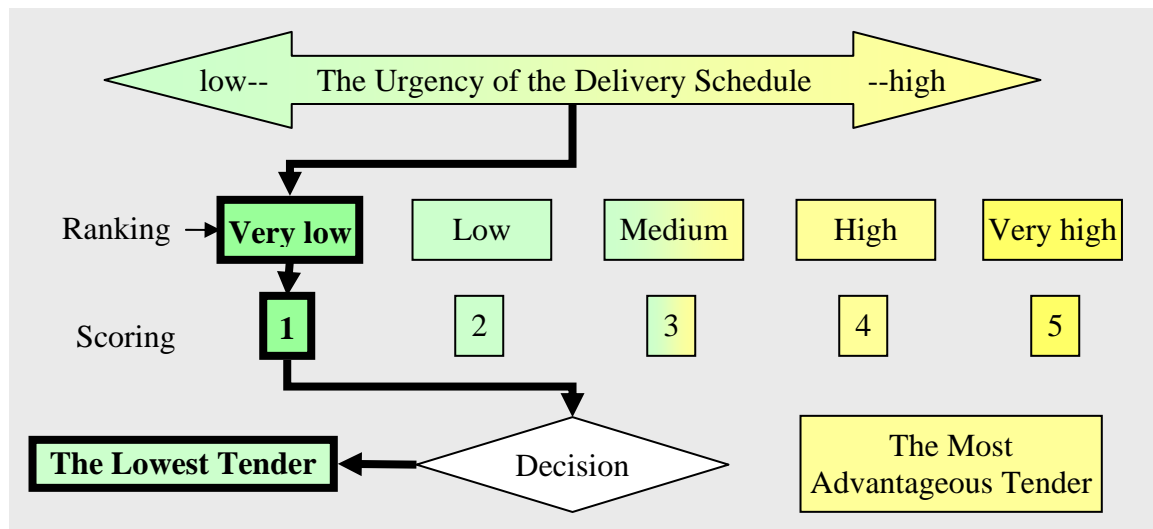


Figure 18. The Determination of Urgency of the Delivery Schedule



## **E. THE MODEL DEVELOPMENT**

In section C and D, a theoretical framework was developed utilizing questions and answers related to a real-life representative procurement situation. In order to integrate a conceptual model in determining an appropriate basis for contract award, the use of a questionnaire is needed in rating the level of each element and characteristic, in addition to a matrix in scoring the rating from the questionnaire and the resulting interpretation.

### **1. The Questionnaire**

Below is an integrated questionnaire in rating the level of each element and characteristic that utilizes the concepts from section C and D, and indicates the level of the heterogeneity and the organization's considerations. This questionnaire is shown in Table 3.

Requirement:									
Code and Factors			Rating	Level	Very Low	Low	Mid	High	Very High
1.0	Heterogeneity Analysis								
1.1	Technology								
1.1.1	How would you rate the level of the specification’s clarity in this requirement?							X	
1.1.2	How would you rate the level of the complexity in this requirement?					X			
1.2	Quality								
1.2.1	How would you rate the level of heterogeneity (perceived difference in the quality of product and performance) in this requirement?					X			
1.2.2	How would you rate the level of suppliers’ opportunity to differentiate the quality, technicality, performance and cost for this requirement?						X		
1.2.3	How would you rate the level of innovation of how the work is to be accomplished in this requirement?				X				
1.3	Management								
1.3.1	How would you rate the level of integration required among contracting parties in this requirement?				X				
1.3.2	How would you rate the level of risk sharing between contractors and government in this requirement?					X			
1.4	Price								
1.4.1	How would you rate the level of availability of price information in this requirement?							X	
2.0	Organization’s Considerations								
2.1	Internal Environment								
2.1.1	How would you rate the level of influence of resources availability in this requirement?						X		
2.1.2	How would you rate the level of conservativeness of coordinating officials (such as inspector generals and comptrollers) within acquisition and procuring entities? As a member of the IPT, how do you rate the level of potential oversight by the inspector general in this requirement?								X
2.1.3	How would you rate the level of urgency of the delivery schedule in this project?				X				

Table 3. The Questionnaire in Rating the Degree of Heterogeneity of Requirements

## 2. The Scoring Matrix

As long as every participant fills out the questionnaire for rating the degree of heterogeneity of requirements, then a rating for each element and characteristic can be applied and the total scores can be calculated to get the average score  $Y_i$ , for  $i=1$  from this sample.

The Name of the Requirement						
Scores		Rating	1	2	3	4
Code and Factors			5			
<b>1.0</b>	<b>Heterogeneity Analysis</b>					
1.1	<b>Technology</b>					
1.1.1	Clarity of Specification		X			
1.1.2	Complexity		X			
1.2	<b>Quality</b>					
1.2.1	Heterogeneity		X			
1.2.2	Differentiation			X		
1.2.3	Innovation	X				
1.3	<b>Management</b>					
1.3.1	Integration	X				
1.3.2	Risk Sharing		X			
1.4	<b>Price</b>					
1.4.1	Price Information Availability		X			
<b>2.0</b>	<b>Organization's Considerations</b>					
2.1	<b>Inner Environment</b>					
2.1.1	Sources Availability			X		
2.1.2	Conservativeness	X				
2.1.3	Urgency	X				
	Count	$A_1$	$B_1$	$C_1$	$D_1$	$E_1$
	Score	$= A_1 \times 1$	$= B_1 \times 2$	$C_1 \times 3$	$= D_1 \times 4$	$= E_1 \times 5$
	Total score	$= A_1 \times 1 + B_1 \times 2 + C_1 \times 3 + D_1 \times 4 + E_1 \times 5 = X_1$				
	Average score	$= \frac{X_1}{A_1 + B_1 + C_1 + D_1 + E_1} = Y_1$				

Table 4. The Scoring of Questionnaire #i.

“There are three different measures that we use to describe the center of a set of data. The first is the best known, the arithmetic mean, which we’ll refer to simply as the

mean. Students may be more familiar with its other name, the average.”<sup>68</sup> In order to get average score for each questionnaire, the following 4 steps must be applied from this questionnaire #i (suppose i=1 here):

(i) count the number of  $A_1, B_1, C_1, D_1$  and  $E_1$

(ii) score the numbers as  $A_1 \times 1, B_1 \times 2, C_1 \times 3, D_1 \times 4$ , and  $E_1 \times 5$

(iii) sum the scores as  $X_1 = A_1 \times 1 + B_1 \times 2 + C_1 \times 3 + D_1 \times 4 + E_1 \times 5$

(iv) average the scores as  $Y_1 = \frac{X_1}{A_1 + B_1 + C_1 + D_1 + E_1}$

### 3. The Interpretation of Scoring

Suppose there are  $n$  samples collected; calculate the mean of scores of each

participant  $\bar{Z} = \frac{\left( \sum_{i=1}^n Y_i \right)}{n}$  and determine the appropriate basis for contract award by utilizing the decision from Table 5.

When  $\bar{Z} > 3$ , the Most Advantageous Tender approach will be an appropriate basis for contract award in a real-life representative procurement situation. On the other hand, when  $\bar{Z} < 3$ , the Lowest Tender approach will be the better one to use. If  $\bar{Z} = 3$ , it means either the Most Advantageous Tender or the Lowest Tender approach will be appropriate.

The appropriate basis for contract award	
If $\bar{Z} > 3$	The Most Advantageous Tender
If $\bar{Z} = 3$	Either the Most Advantageous or Lowest Tender
If $\bar{Z} < 3$	The Lowest Tender

Table 5. The Total Average Score from Each Questionnaire

<sup>68</sup> Keller, G., & Warrack, B. (2003). *Statistics for Management and Economics*. (6th ed.) (p. 93). Pacific Grove, CA: Brooks/Cole.

## F. THE RESULT OF THE WASTE DISPOSAL EXAMPLE

After scoring each element and characteristic related to a real-life representative procurement situation, the waste disposal services required by a Taiwan military hospital, a questionnaire to rate the evaluation and one matrix of that calculates the scoring are applied to the determination of an appropriate basis for contract award.

### 1. The Questionnaire Simulation of Evaluating Rating

Below is a simplified evaluation questionnaire for rating the degree of the heterogeneity and the organization's considerations. A rating of the degree of each element and characteristic is depicted in Table 6.

Requirement: Waste Disposal Services Contract of a Taiwan Military Hospital							
Rating Code and Factors		Level	Very Low	Low	Mid	High	Very High
1.0	Heterogeneity Analysis						
1.1	Technology						
1.1.1	Clarity of Specification						X
1.1.2	Complexity	X					
1.2	Quality						
1.2.1	Heterogeneity	X					
1.2.2	Differentiation	X					
1.2.3	Innovation	X					
1.3	Management						
1.3.1	Integration			X			
1.3.2	Risk Sharing	X					
1.4	Price						
1.4.1	Price Information Availability				X		
2.0	Organization's Considerations						
2.1	Internal Environment						
2.1.1	Resources Availability						X
2.1.2	Conservativeness					X	
2.1.3	Urgency						X

Table 6. The Rating of the Degree of Elements and Characteristics.

## 2. The Matrix Simulation of Calculating Scores

A matrix of the scores, the degree of the heterogeneity, and the organization's considerations are dependant on the previous matrix of ratings. Combining these ratings, a table that scores the degree of each element and characteristic can be calculated as shown in Table 7.

Requirement: Waste Disposal Service Contract of a Taiwan Military Hospital							
Scores		Rating	1	2	3	4	5
Code and Factors							
1.0	Heterogeneity Analysis						
1.1	Technology						
1.1.1	Clarity of Specification	X					
1.1.2	Complexity	X					
1.2	Quality						
1.2.1	Heterogeneity	X					
1.2.2	Differentiation	X					
1.2.3	Innovation	X					
1.3	Management						
1.3.1	Integration		X				
1.3.2	Risk Sharing	X					
1.4	Price						
1.4.1	Price Information Availability			X			
2.0	Organization's Considerations						
2.1	Internal Environment						
2.1.1	Resources Availability	X					
2.1.2	Conservativeness		X				
2.1.3	Urgency	X					
	Count	8	2	1			
	Score	= 8×1	= 2×2	= 1×3			
	Total Score	= 8 + 4 + 3 = 15					
	Average Score	15 ÷ 11 = 1.36					

Table 7. Matrix Simulation Scores of the Rating Level

There are eight elements and characteristics scored as 1 point, two are given 2 points, and one is given 3 points. Multiplying these scores, the total score equals  $8 \times 1 + 2 \times 2 + 1 \times 3 = 15$ . In order to measure the average in scoring these 11 elements and

characteristics, we can calculate using the following formula:

$$\frac{8 \times 1 + 2 \times 2 + 1 \times 3}{11} = \frac{15}{11} = 1.36$$

### 3. The Interpretation of Scores

Within Table 7, the average score of these 11 elements and characteristics is 1.36. Since it is less than 3 points, it can be inferred that the Lowest Tender approach will be the appropriated basis for a waste disposal service contract award. The interpretation of the appropriated basis for contract award is shown in Figure 19.

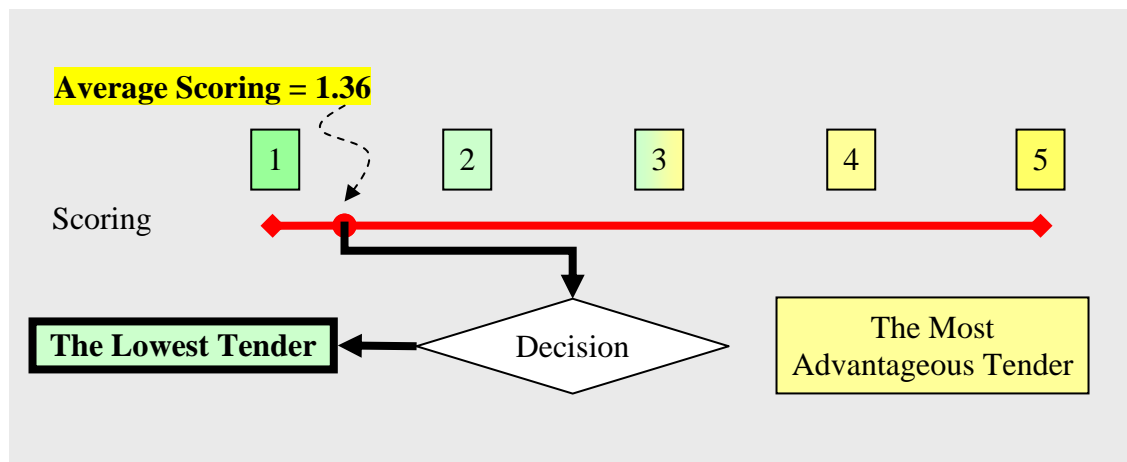


Figure 19. The Interpretation of the Appropriated Basis for Contract Award

## G. SUMMARY

Within the theoretical framework, its development, the analysis of heterogeneity, and the analysis of the organization's consideration, the determination of the degree of heterogeneity can be summarized in the model development. The next chapter will utilize this model to simulate two real-life representative procurement situations that test this model and whether the Lowest Tender approach or the Most Advantageous Tender approach is the most appropriate basis for contract award.

## **IV. MODEL APPLICATION EXAMPLE**

In Chapter III, factors were identified and a model developed to be included in a questionnaire, which is to be answered by contracting officers or program officers who will execute acquisition planning to determine an appropriate basis for contract award in response to a realistic procurement situation. These factors will be utilized in determining the level of heterogeneity as well as the level of the organization's considerations, and will support the conclusion of an appropriate basis for contract award. This chapter will apply the model and analyze the data resulting from the questionnaire. This model will help program officers and contracting officers determine an appropriate basis for contract award.

### **A. THE REQUIREMENT SELECTED**

In order to test whether the model works, two realistic procurement situations have been selected to test the model. One is a requirement of information technology services at Naval Postgraduate School (NPS); another is the requirement for custodial services at NPS. Suppose the workforce of the U.S. military has been downsized by a significant level and the NPS must outsource these two services. The following is an explanation of the requirement background in utilizing these two kinds of service contracts:

#### **1. The Information Technology Services Contract at NPS**

Suppose NPS has an information technology (IT) system to integrate campus operations. Traditionally, NPS has maintained its IT system service in-house. NPS just received extra funding from the NAVY that must be spent as soon as possible. The current IT system is obsolete and needs to be upgraded in order to provide a better service for faculty, students, and external military and non-military users. Because of downsizing, NPS must outsource and to award a contract to acquire IT service for the school. During the solicitation process, contractors will be provided with information on buildings, floors, acreage of campus, and current installed facilities data for performing IT services. In



order to perform this service, contractors must meet certain specifications and requirements as shown in Table 8.

◆	Develop and maintain the IT system to incorporate the latest IT technology
◆	Design website for communication among users
◆	Design information systems (including Data Processing System, Management Information System, Decision Support System, Executive Information System, Expert System, and Intelligent Agents)
◆	Repair and maintain hardware and modify software for the purpose of on-call or periodical service
◆	Upgrade to new software versions as required
◆	Train users

Table 8. The Specifications of Requirement in IT Services Contract

## 2. The Custodial Services Contract at NPS

Historically, NPS has maintained its custodial services in-house. Because of downsizing, NPS must outsource custodial services for faculty, students, and users on campus. During the solicitation process, the contractors will be provided with information regarding buildings, floors, acreage of campus, and current installed facilities data for performing custodial services. In order to perform this service, contractors must meet the following specifications and requirements. Table 9 is a partial list of more detailed specifications for the custodial services contract.

◆	Use carts daily to collect recyclable and non-recyclable trash from trash cans to garbage yard on campus
◆	Separate recyclable and non-recyclable trash daily
◆	Clean every classroom and toilets of each building daily
◆	Refill and maintain sufficient sanitary supplies for each toilet daily
◆	Mop floors and stairs for each building weekly
◆	Clean sidewalks on campus weekly
◆	Wax floors for each building monthly
◆	Use qualified manpower, non-toxic materials, and standard of cleaning (such as setting up caution boards) in performing service

Table 9. The Specifications of Requirement in Custodial Services Contract

The participants are required to rate the level of the following 11 factors, which are addressed in Table 10, as if they are members of the Integrated Product Team (IPT) conducting the two procurements.

The Name of the Requirement		Rating the level				
Code	Factors	Very Low	Low	Mid	High	Very High
<b>1.1</b>	<b>Technology</b>					
1.1.1	How would you rate the level of the specification's clarity in this requirement?					
1.1.2	How would you rate the level of the complexity in this requirement?					
<b>1.2</b>	<b>Quality</b>					
1.2.1	How would you rate the level of heterogeneity (perceive difference in the quality of product and performance) in this requirement?					
1.2.2	How would you rate the level of suppliers' opportunity to differentiate the quality, technicality, performance and cost for this requirement?					
1.2.3	How would you rate the level of innovation of how the work is to be accomplished in this requirement?					
<b>1.3</b>	<b>Management</b>					
1.3.1	How would you rate the level of integration required among contracting parties in this requirement?					
1.3.2	How would you rate the level of risk sharing between contractors and government in this requirement?					
<b>1.4</b>	<b>Price</b>					
1.4.1	How would you rate the level of availability of price information in this requirement?					
<b>2.1</b>	<b>Internal Environment</b>					
2.1.1	How would you rate the level of influence of resources availability in this requirement?					
2.1.2	How would you rate the level of conservativeness of coordinating officials (such as inspector generals and comptrollers) within acquisition and procuring entities? As a member of the IPT, how do you rate the level of potential oversight by the IG in this requirement?					
2.1.3	How would you rate the level of urgency of the delivery schedule in this project?					

Table 10. The Questionnaire for Services Contract

## B. SURVEY RESULTS

The survey was completed by twenty-five participants. They are the current students of the Business and Public Policy School and have taken business courses for

more than three quarters. The business courses are related to acquisition and contract management. After describing the purpose of this survey and briefing the participants, the completed two questionnaires and were able to rate the level of each factor in a few minutes without asking any questions. All of the questionnaires were qualified to be analyzed by using the following scoring table.

Scores		Rating	Very Low, Short	Low, Short	Mid	High, Long	Very High, Long
Code and Factors							
<b>1.1</b>	<b>Technology</b>						
1.1.1	Clarity of Specification	5	4	3	2	1	
1.1.2	Complexity	1	2	3	4	5	
<b>1.2</b>	<b>Quality</b>						
1.2.1	Heterogeneity	1	2	3	4	5	
1.2.2	Differentiation	1	2	3	4	5	
1.2.3	Innovation	1	2	3	4	5	
<b>1.3</b>	<b>Management</b>						
1.3.1	Integration	1	2	3	4	5	
1.3.2	Risk Sharing	1	2	3	4	5	
<b>1.4</b>	<b>Price</b>						
1.4.1	Price Information Availability	5	4	3	2	1	
<b>2.1</b>	<b>Internal Environment</b>						
2.1.1	Resources Availability	5	4	3	2	1	
2.1.2	Conservativeness	5	4	3	2	1	
2.1.3	Urgency	1	2	3	4	5	

Table 11. The Scoring Table for Questionnaire

## 1. Information Technology Services

After evaluating the questionnaire for the IT services contract and rating the level of each factor by participants, scores were assigned to each rating by utilizing Table 11. For the rating by each participant, the average score was calculated and presented in the

last column by utilizing this formula:  $Average\ score_{\# of\ Participant} = \frac{\sum_{Code=1.1.1}^{2.1.3} Score}{11}$ . The

results are shown in Table 12.

Score Code # of Participant	1.1.1	1.1.2	1.2.1	1.2.2	1.2.3	1.3.1	1.3.2	1.4.1	2.1.1	2.1.2	2.1.3	Average Score
01	4	5	5	5	4	5	4	3	2	4	3	4.000
02	4	4	2	5	5	4	4	5	3	3	4	3.909
03	3	4	4	4	4	5	3	1	1	2	5	3.273
04	2	2	3	5	4	4	2	4	3	3	4	3.273
05	1	4	4	4	4	3	3	5	5	3	4	3.636
06	2	5	3	5	5	4	4	4	5	1	5	3.909
07	3	3	3	4	4	3	3	5	3	4	2	3.364
08	4	4	3	4	4	5	3	4	3	3	5	3.818
09	4	4	4	5	4	5	4	2	1	3	5	3.727
10	4	4	2	2	5	5	5	5	2	2	4	3.636
11	3	4	4	4	4	3	3	5	2	3	5	3.636
12	3	5	3	4	3	3	3	5	4	3	2	3.455
13	4	4	3	4	4	4	3	3	4	3	3	3.545
14	4	3	3	2	3	3	3	4	4	3	4	3.273
15	4	3	3	4	3	2	3	4	4	4	3	3.364
16	5	4	3	3	4	3	4	2	2	4	4	3.455
17	5	5	3	4	3	2	2	1	2	3	5	3.182
18	2	4	4	3	4	4	5	2	3	1	5	3.364
19	4	5	4	4	3	5	2	2	1	3	2	3.182
20	4	3	5	5	5	1	5	2	2	5	5	3.818
21	4	2	5	5	5	5	4	3	2	2	4	3.727
22	2	4	4	4	4	2	3	2	4	2	3	3.091
23	5	5	5	5	5	1	5	5	3	4	2	4.091
24	4	4	2	3	2	4	3	3	1	4	5	3.182
25	4	3	4	5	5	5	3	1	1	2	4	3.364
<b>Mean</b>												<b>3.531</b>

Table 12. The Scoring Table for IT Services Contract Questionnaire

This table shows that the mean is 3.531 as calculated by using this formula:

$$Mean_{\# \text{ of Average Score}} = \bar{x} = \frac{\sum_{\# \text{ of Participant}=01}^{25} \text{Average Score}}{25} . \text{ It can be inferred that the Most}$$

Advantageous Tender is the appropriate basis for awarding the information technology services contract.

## 2. Custodial Services

After evaluating the questionnaire for the custodial services contract and rating the level of each factor by participants, scores were assigned to each rating by utilizing Table 11. For the rating by each participant, the average score was calculated and presented in the last column by utilizing this formula:

$$Average\ score_{\# of\ Participant} = \frac{\sum_{Code=1.1.1}^{2.1.3} score}{11} . \text{ The results are shown in Table 13.}$$

Score Code # of Participant	1.1.1	1.1.2	1.2.1	1.2.2	1.2.3	1.3.1	1.3.2	1.4.1	2.1.1	2.1.2	2.1.3	Average Score
01	1	1	2	2	2	2	1	1	4	5	4	2.273
02	2	2	3	2	2	2	2	3	3	4	4	2.636
03	2	2	2	2	3	2	1	1	3	4	5	2.455
04	1	3	4	4	3	4	2	2	3	3	3	2.909
05	4	1	3	3	2	2	1	2	2	5	3	2.545
06	1	2	2	2	2	2	2	3	3	4	2	2.273
07	3	2	2	3	1	2	2	5	4	4	1	2.636
08	2	2	3	2	2	2	2	3	4	4	4	2.727
09	2	2	2	3	2	3	2	1	3	4	3	2.455
10	2	1	2	4	1	1	1	2	4	2	1	1.909
11	1	1	1	3	2	2	1	5	4	4	1	2.273
12	2	1	3	2	2	2	2	2	3	4	5	2.545
13	2	2	3	2	2	2	2	2	3	4	4	2.545
14	2	3	3	2	3	4	3	2	3	3	4	2.909
15	2	3	3	2	2	2	3	4	4	3	3	2.818
16	2	2	3	2	2	2	2	2	2	3	4	2.364
17	3	2	2	2	2	2	2	1	4	4	2	2.364
18	3	2	3	3	2	2	3	3	3	4	3	2.818
19	3	1	2	2	2	4	2	2	2	4	4	2.545
20	5	1	2	2	2	1	1	4	4	5	2	2.636
21	2	2	2	2	2	2	2	2	3	4	3	2.364
22	4	2	3	3	2	2	4	3	3	3	3	2.909
23	4	2	2	3	2	4	2	4	2	3	2	2.727
24	2	1	1	1	1	2	2	1	2	5	4	2.000
25	2	1	5	5	3	3	3	1	4	1	4	2.909
<b>Mean</b>												<b>2.542</b>

Table 13. The Scoring Table for Custodial Services Contract Questionnaire

This table shows that the mean is 2.542 as calculated by utilizing this

formula:  $Mean_{\# \text{ of Average Score}} = \bar{x} = \frac{\sum_{i=1}^{25} \text{Average Score}}{\# \text{ of Participant}=01}$  . It can be inferred that the

Lowest Tender is the appropriate basis for awarding the custodial services contract.

### C. CALCULATION AND INTERPRETATION OF STATISTICS

In order to test whether the model developed in Chapter III works appropriately, *variance analysis* is utilized to confirm the result of the survey.

The *variance* and its related measure, *the standard deviation*, are arguably the most important statistics. They are used to measure variability, but as you will discover, they play a vital role in almost all statistical inference procedures.<sup>69</sup>

The formula of sample variance and standard deviation are as follows:

$$\text{Sample variance : } s^2 = \frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n-1}$$

$$\text{Sample standard deviation : } s = \sqrt{s^2}$$

Technically, the sample variance is calculated by dividing the sum of squared deviations by *n*. The statistic computed by dividing the sum of squared deviations by *n-1* is called the *sample variance corrected for the mean*. Because this statistic is used extensively, we will shorten its name to *sample variance*.<sup>70</sup>

#### 1. Variance Analysis of IT Services Contract Survey

To compute the sample variance  $s^2$  of the IT services contract survey, we begin by utilizing the sample mean  $\bar{x}=3.531$ . Then the formula of sample variance and sample standard deviation mentioned above are applied to get the sample variance and sample standard deviation of the IT service contract:

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<sup>69</sup> Keller, G., & Warrack, B. (2003). *Statistics for Management and Economics*. (6th ed.) (p. 102). Pacific Grove, CA: Brooks/Cole.

<sup>70</sup> Ibid.

$$\begin{aligned} \text{Sample variance of IT service: } s_{IT}^2 \\ = \frac{(3.531 - 4.000)^2 + (3.531 - 3.909)^2 + \dots + (3.531 - 3.364)^2}{25 - 1} = 0.082 \end{aligned}$$

$$\begin{aligned} \text{Sample standard deviation of IT service: } s_{IT} \\ = \sqrt{s_{IT}^2} = \sqrt{0.082} = 0.287 \end{aligned}$$

Knowing the mean and standard deviation allows the statistics practitioner to extract useful information. According to the Empirical Rule, “Approximately 68% of all observations fall within one standard deviation of the mean.”<sup>71</sup> Using this IT services contract survey as an example, it can be calculated that approximately 68% will fall within the interval of 3.244 to 3.818 by utilizing following formula.

$$\bar{x} \pm 1 \times s_{IT} = 3.531 \pm 1 \times 0.287 = [3.244, 3.818]$$

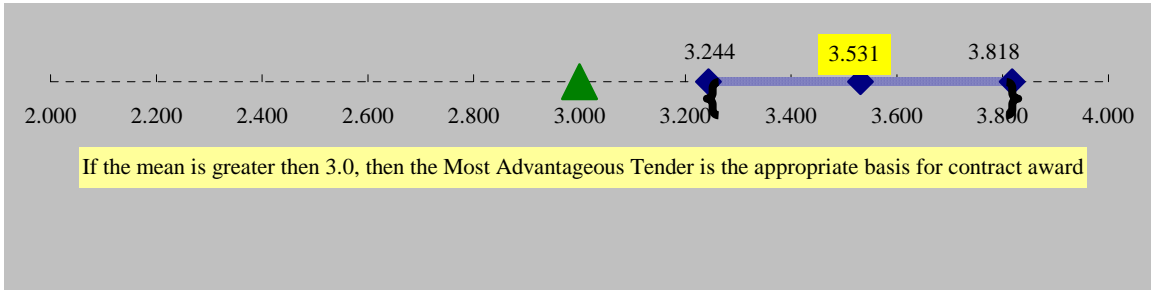


Figure 20. The Mean's Interval for IT Services Contract

It can be inferred that approximately 68% of the participants would agree there is a precise relationship between the eleven factors of heterogeneity and organization's considerations and this IT requirement. That is to say, this result matches the original assumption in Chapter III E.3. As long as the mean score is greater than 3.0, then the Most Advantageous Tender will be the appropriate basis for contract award in similar requirements.

## 2. Variance Analysis of Custodial Services Contract Survey

To compute the sample variance  $s^2$  for the custodial services contract survey, we use the sample mean  $\bar{x} = 2.542$ . We then apply the formula of sample variance and

sample standard deviation mentioned above to get the sample variance and sample standard deviation for this custodial service contract:

$$\begin{aligned} \text{Sample variance of custodial service : } s_c^2 \\ = \frac{(2.542 - 2.273)^2 + (2.542 - 2.636)^2 + \dots + (2.542 - 2.909)^2}{25 - 1} = 0.075 \end{aligned}$$

$$\begin{aligned} \text{Sample standard deviation of custodial service : } s_c \\ = \sqrt{s_c^2} = \sqrt{0.075} = 0.275 \end{aligned}$$

Using this custodial services contract survey as an example, it can be calculated that approximately 68% will fall within the interval of 2.267 to 2.816 by utilizing the following formula:

$$\bar{x} \pm 1 \times s_c = 2.542 \pm 1 \times 0.275 = [2.267, 2.816]$$

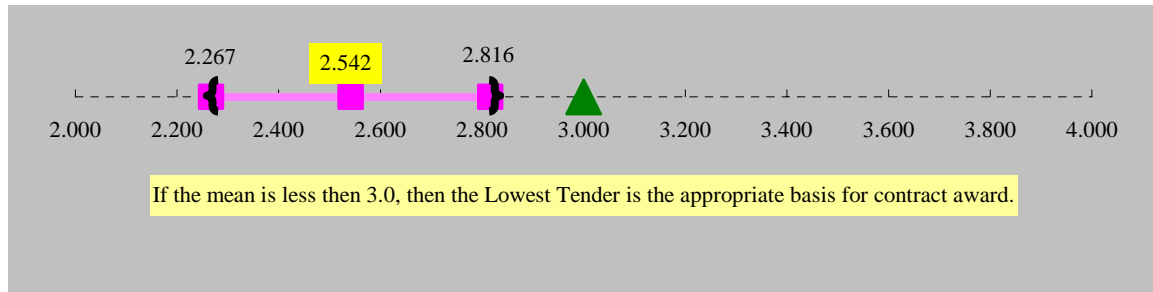


Figure 21. The Mean's Interval for Custodial Services Contract

It can be inferred that approximately 68% of the participants would agree there is a precise relationship between the between the eleven factors of heterogeneity and organization's considerations and this custodial requirement. That is to say, this result matches the original assumption in Chapter III E.3. As long as the mean score is less than 3.0, then the Lowest Tender will be the appropriate basis for contract award in similar requirements.

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<sup>71</sup> Keller, G., & Warrack, B. (2003). *Statistics for Management and Economics*. (6th ed.) (p. 106). Pacific Grove, CA: Brooks/Cole.



## **D. FURTHER DISCUSSION**

There are eleven factors included in each survey, eight of which are related to heterogeneity analysis, such as the specification's clarity, complexity, heterogeneity, suppliers' opportunity to differentiate, innovation, integration, risk sharing and availability of price information. The other factors are related to the organization's considerations, such as the influence of resources availability, conservativeness, and urgency.

When analyzed further, it is interesting to note that if the factors related to the organization's considerations are removed from the data analysis, the mean, sample variance, and sample standard deviation of the two samples vary. After removing the factors related to the organization's considerations, the greater mean in the IT example and the less mean in the custodial example become more pronounced than before. However, even with the removal of the factors of the organization's considerations, the results of the model still point toward the same conclusions of the appropriate basis for contract award. The following discussions illustrate this point.

### **1. Further Analysis of IT Services Contract Survey**

If we remove the factors related to the organization's considerations from the IT services contract survey, the resulting mean, sample, and sample standard deviation within this sample will be as follows:

#### ***a. Result of the Mean***

The mean for the IT services contract is greater than the previous one. The new mean of this sample is 3.665. The data are shown in Table 14.

Score Code # of Participant	1.1.1	1.1.2	1.2.1	1.2.2	1.2.3	1.3.1	1.3.2	1.4.1	Average Score
01	4	5	5	5	4	5	4	3	4.375
02	4	4	2	5	5	4	4	5	4.125
03	3	4	4	4	4	5	3	1	3.500
04	2	2	3	5	4	4	2	4	3.250
05	1	4	4	4	4	3	3	5	3.500
06	2	5	3	5	5	4	4	4	4.000
07	3	3	3	4	4	3	3	5	3.500
08	4	4	3	4	4	5	3	4	3.875
09	4	4	4	5	4	5	4	2	4.000
10	4	4	2	2	5	5	5	5	4.000
11	3	4	4	4	4	3	3	5	3.750
12	3	5	3	4	3	3	3	5	3.625
13	4	4	3	4	4	4	3	3	3.625
14	4	3	3	2	3	3	3	4	3.125
15	4	3	3	4	3	2	3	4	3.250
16	5	4	3	3	4	3	4	2	3.500
17	5	5	3	4	3	2	2	1	3.125
18	2	4	4	3	4	4	5	2	3.500
19	4	5	4	4	3	5	2	2	3.625
20	4	3	5	5	5	1	5	2	3.750
21	4	2	5	5	5	5	4	3	4.125
22	2	4	4	4	4	2	3	2	3.125
23	5	5	5	5	5	1	5	5	4.500
24	4	4	2	3	2	4	3	3	3.125
25	4	3	4	5	5	5	3	1	3.750
<b>Mean</b>									<b>3.665</b>

Table 14. Scoring Table of IT Services Contract Without Organization's Consideration

**b. Result of the Sample Variance and Standard Deviation**

The sample variance and simple standard deviation of the IT services contract are now more than the previous two.

$$\begin{aligned}
 &\text{New sample variance of IT service : } s_{IT}^2 \\
 &= \frac{(3.665 - 4.375)^2 + (3.665 - 4.125)^2 + \dots + (3.665 - 3.750)^2}{25 - 1} = 0.153
 \end{aligned}$$

$$= \sqrt{s_{IT}^2} = \sqrt{0.153} = 0.392$$

*The new interval of mean in IT services contract :*

$$\bar{x} \pm 1 \times s_{IT^*} = 3.665 \pm 1 \times 0.392 = [3.273, 4.057]$$

Using this IT services contract survey as an example, it can be calculated that approximately 68% will fall within the interval of 3.273 to 4.057. It can be inferred that approximately 68% of the participants would agree there is a precise relationship between the eight factors of heterogeneity and this IT requirement. That is to say, this result also matches the original assumption in Chapter III E.3. The Most Advantageous Tender will also be an appropriate basis for contract award in similar requirements.

Comparing the modified mean, 3.665, to the previous mean, 3.531, it can be inferred that the new model without the organization's considerations will be more pronounced with the higher mean than what Figure 22 reflects. Based on this analysis, it can be inferred that the factors of organization's considerations results in the dampening of contracting officers and program officers use of business judgment in developing acquisition strategy and in determining the appropriate basis for contract award.

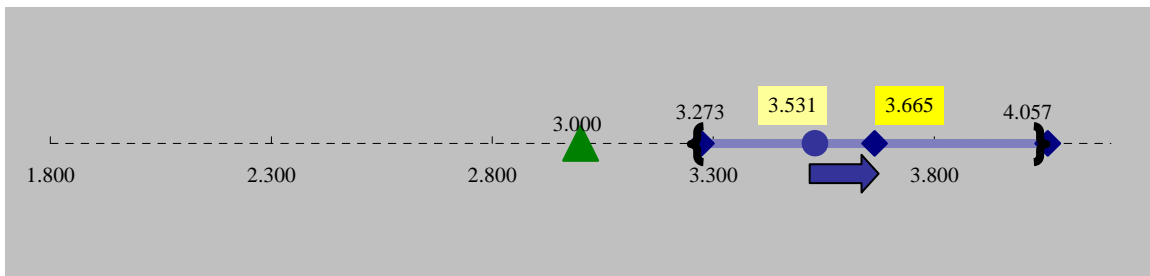


Figure 22. The Mean Difference of IT Services Contract

## 2. Further Analysis of Custodial Services Contract Survey

If we remove the factors related to the organization's considerations from the custodial services contract survey, the resulting mean, sample, and sample standard deviation within the sample will be as follows:

*a. Result of the Mean*

The mean for the custodial services contract is less than the previous one.

The new mean for this sample is 2.245. The data are shown in Table 15.

Score Code # of Participant	1.1.1	1.1.2	1.2.1	1.2.2	1.2.3	1.3.1	1.3.2	1.4.1	Average Score
01	1	1	2	2	2	2	1	1	1.500
02	2	2	3	2	2	2	2	3	2.250
03	2	2	2	2	3	2	1	1	1.875
04	1	3	4	4	3	4	2	2	2.875
05	4	1	3	3	2	2	1	2	2.250
06	1	2	2	2	2	2	2	3	2.000
07	3	2	2	3	1	2	2	5	2.500
08	2	2	3	2	2	2	2	3	2.250
09	2	2	2	3	2	3	2	1	2.125
10	2	1	2	4	1	1	1	2	1.750
11	1	1	1	3	2	2	1	5	2.000
12	2	1	3	2	2	2	2	2	2.000
13	2	2	3	2	2	2	2	2	2.125
14	2	3	3	2	3	4	3	2	2.750
15	2	3	3	2	2	2	3	4	2.625
16	2	2	3	2	2	2	2	2	2.125
17	3	2	2	2	2	2	2	1	2.000
18	3	2	3	3	2	2	3	3	2.625
19	3	1	2	2	2	4	2	2	2.250
20	5	1	2	2	2	1	1	4	2.250
21	2	2	2	2	2	2	2	2	2.000
22	4	2	3	3	2	2	4	3	2.875
23	4	2	2	3	2	4	2	4	2.875
24	2	1	1	1	1	2	2	1	1.375
25	2	1	5	5	3	3	3	1	2.875
<b>Mean</b>									<b>2.245</b>

Table 15. Scoring Table of Custodial Services Contract Without Organization's Consideration

***b. Result of the Sample Variance and Standard Deviation***

The sample variance and simple standard deviation of the custodial service contract are now more than the previous two.

$$\begin{aligned} &\text{New sample variance of custodial service: } s_{c^*}^2 \\ &= \frac{(2.245 - 1.500)^2 + (2.245 - 2.250)^2 + \dots + (2.245 - 2.875)^2}{25 - 1} = 0.176 \end{aligned}$$

$$\begin{aligned} &\text{New sample standard deviation of custodial service: } s_{c^*} \\ &= \sqrt{s_{c^*}^2} = \sqrt{0.176} = 0.420 \end{aligned}$$

$$\begin{aligned} &\text{The new interval of mean in custodial services contract :} \\ &\bar{x} \pm 1 \times s_{c^*} = 2.245 \pm 1 \times 0.420 = [1.825, 2.665] \end{aligned}$$

Using this custodial services contract survey as an example, it can be calculated that approximately 68% will fall within the interval of 1.825 to 2.665. It can be inferred that approximately 68% of the participants would agree there is a precise relationship between the eight factors of heterogeneity and this custodial requirement. That is to say, this result also matches the original assumption in Chapter III E.3. The Lowest Tender will also be an appropriate method for contract award in similar requirements.

Comparing the modified mean, 2.245, to the previous mean, 2.542, it can be inferred that the new model without the organization's considerations will be more pronounced with the lower mean than what Figure 23 reflects. Based on this analysis, it can be inferred that the factors of organization's considerations results in the dampening of contracting officers and program officers use of business judgment in developing acquisition strategy and in determining the appropriate basis for contract award.

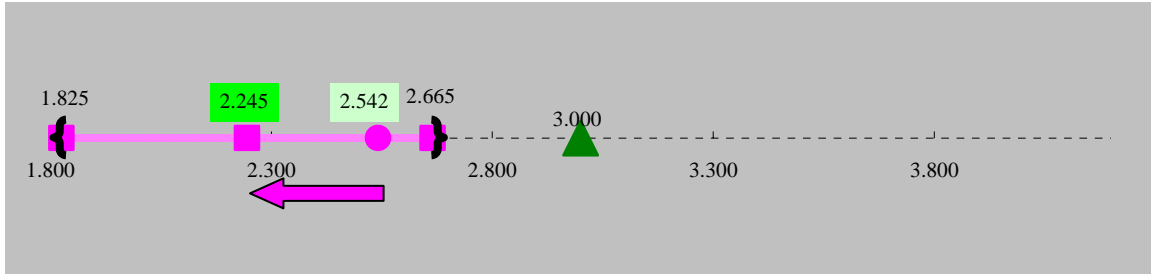


Figure 23. The Mean Difference of Custodial Services Contract

### 3. Vertical Analysis of Factors

Further analysis is related to the factors themselves within the two samples. As long as we average the scores of each factor, the level of each factor varies in these two different types of services contracts.

#### a. *Relative Importance of Evaluation Factors in IT Services Contract*

According to the average of each factor, the factors such as differentiation, innovation, complexity, and integration are more significant than factors such as specification's clarity, heterogeneity, risk sharing, and price information availability in determining the Most Advantageous Tender as the appropriate basis for contract award. The means of each factor are calculated by utilizing this formula:

$$Mean_{factor} = \bar{x} = \frac{\sum_{i=1}^{25} Score}{\# of Participant=01 \times 25}, \text{ and are reflected in Table 16:}$$

Score Code # of Participant	1.1.1	1.1.2	1.2.1	1.2.2	1.2.3	1.3.1	1.3.2	1.4.1
01	4	5	5	5	4	5	4	3
02	4	4	2	5	5	4	4	5
03	3	4	4	4	4	5	3	1
04	2	2	3	5	4	4	2	4
05	1	4	4	4	4	3	3	5
06	2	5	3	5	5	4	4	4
07	3	3	3	4	4	3	3	5
08	4	4	3	4	4	5	3	4
09	4	4	4	5	4	5	4	2
10	4	4	2	2	5	5	5	5
11	3	4	4	4	4	3	3	5
12	3	5	3	4	3	3	3	5
13	4	4	3	4	4	4	3	3
14	4	3	3	2	3	3	3	4
15	4	3	3	4	3	2	3	4
16	5	4	3	3	4	3	4	2
17	5	5	3	4	3	2	2	1
18	2	4	4	3	4	4	5	2
19	4	5	4	4	3	5	2	2
20	4	3	5	5	5	1	5	2
21	4	2	5	5	5	5	4	3
22	2	4	4	4	4	2	3	2
23	5	5	5	5	5	1	5	5
24	4	4	2	3	2	4	3	3
25	4	3	4	5	5	5	3	1
Mean	3.52	<b>3.88</b>	3.52	<b>4.08</b>	<b>4.00</b>	<b>3.60</b>	3.44	3.28
Relative Importance	5	<b>3</b>	5	<b>1</b>	<b>2</b>	<b>4</b>	6	7

Table 16. The Factor's Mean for IT Services Contracts

Whereas the factor's mean is greater than 3.0 points, the means of differentiation, innovation, complexity, and integration are higher than the other means. It can be inferred that these evaluation factors of differentiation and innovation have relatively higher importance than the other factors in this sample.

***b. Relative Importance of Evaluation Factors in Custodial Services Contract***

According to the average of each factor, the factors such as complexity, risk sharing, innovation, and integration have more significant levels than the

specification's clarity, price information availability, heterogeneity, and differentiation in determining the Lowest Tender as the appropriate basis for contract award. The means of

each factor are calculated by utilizing this formula:  $Mean_{factor} = \bar{x} = \frac{\sum_{i=1}^{25} Score}{25}$ ,  
 $\frac{\# of Participant=01}{25}$ ,

and are reflected in Table 17:

Score Code # of Participant	1.1.1	1.1.2	1.2.1	1.2.2	1.2.3	1.3.1	1.3.2	1.4.1
01	1	1	2	2	2	2	1	1
02	2	2	3	2	2	2	2	3
03	2	2	2	2	3	2	1	1
04	1	3	4	4	3	4	2	2
05	4	1	3	3	2	2	1	2
06	1	2	2	2	2	2	2	3
07	3	2	2	3	1	2	2	5
08	2	2	3	2	2	2	2	3
09	2	2	2	3	2	3	2	1
10	2	1	2	4	1	1	1	2
11	1	1	1	3	2	2	1	5
12	2	1	3	2	2	2	2	2
13	2	2	3	2	2	2	2	2
14	2	3	3	2	3	4	3	2
15	2	3	3	2	2	2	3	4
16	2	2	3	2	2	2	2	2
17	3	2	2	2	2	2	2	1
18	3	2	3	3	2	2	3	3
19	3	1	2	2	2	4	2	2
20	5	1	2	2	2	1	1	4
21	2	2	2	2	2	2	2	2
22	4	2	3	3	2	2	4	3
23	4	2	2	3	2	4	2	4
24	2	1	1	1	1	2	2	1
25	2	1	5	5	3	3	3	1
Mean	2.36	1.76	2.52	2.52	2.04	2.32	2.00	2.44
Relative Importance	5	1	7	7	3	4	2	6

Table 17. The Factor's Mean for Custodial Services Contracts



Whereas the factor's mean is less than 3.0 points, the means of complexity, risk sharing, innovation, and integration have higher levels than the other means. It can be inferred that these evaluation factors of complexity and risk sharing have relatively higher importance than the other factors in this sample.

## **E. SUMMARY**

The purpose of this chapter was to apply the model and analyze the data resulting from the questionnaire. The results of this application shows that this model can be used in a real world by the IPT, contracting officers, program officers, and engineers in determining an appropriate basis for contract award.

The model shows that when the mean of evaluation factor ratings is greater than 3.0, the Most Advantageous Tender approach is the appropriate basis for contract award. The model also shows that when the mean of evaluation factor ratings is less than 3.0, the Lowest Tender approach is the appropriate basis for contract award.

Moreover, the utilization of factors of organization's considerations resulting from this survey shows that the internal factors dampen contracting officers' and program officers' use of business judgment in developing acquisition strategy and in determining the appropriate basis for contract award.

Furthermore, whereas the factor's mean is greater than 3.0 points, the means of differentiation and innovation are higher than the other means. It can be inferred that these evaluation factors have relatively higher importance than the other factors in this research. On the other hand, whereas the factor's mean is less than 3.0 points, the means of complexity and risk sharing have higher levels than the other means. It can be inferred that these evaluation factors have relatively higher importance than the other factors in this research.

In the next chapter, a summary of the research will be presented, as well as appropriate conclusions, recommendations, and suggestions for some further research.

## **V. SUMMARY**

The purpose of this research paper was to develop a model to be used by contracting officers and program officers in determining the appropriate basis for contract award, either the Lowest Tender or the Most Advantageous Tender. This model was developed using results of literature review which focused on heterogeneity and the varies elements that characterize heterogeneity.

Chapter I introduced the concepts of heterogeneity and its relationship to the appropriate basis for contract award. It discussed the background and purpose of the research. In addition, it introduced the research questions and methodology used. Finally, it provided the framework for the report format, and listed the potential benefits of this study.

Chapter II provided the literature review which summarized the procurement process within the entities of the Taiwan MND. Within the descriptions, explanations of the advantages and disadvantages to the basis for contract award (the Lowest Tender and the Most Advantageous Tender), the key heterogeneous judgments, and an organization's considerations are discussed.

In Chapter III a model was developed to determine the appropriate basis for contract award. In addition to the explanations for the need of a theoretical framework, descriptions of the theoretical framework, analysis of heterogeneity, and considerations of the organization, how the degree of heterogeneity can be determined is summarized in the development of the model.

In Chapter IV the model developed in Chapter III was tested by twenty five MBA students at NPS. These participants have taken business courses related to acquisition and contract management for more than three quarters. They have taken part in a survey by providing two real-life scenarios. The application of this model proves that this model is a useful instrument in determining the appropriate method for contract award. Within the explanations of the selected requirement, the results of the survey, and the result, it is shown that this model can be utilized in the real world by the IPT, such as by contracting

officers, program officers, and engineers. For a mean greater than 3.0, the Most Advantageous Tender approach is the appropriate basis for contract award. For a mean less than 3.0, the Lowest Tender approach is the appropriate basis for contract award.

## **A. CONCLUSIONS**

According to the discussions in Chapter IV, the model developed to determine the appropriate basis for contract award proves to be a useful instrument. This model provides benefit to the program officers and contracting officers where they would otherwise feel ambiguous in determining what is the appropriate basis for contract award.

Factors extracted from the literature review and utilized in analyzing the heterogeneity are relevant not only to services contracts, but also to supply contracts and major weapons system contracts. As long as program officers and contracting officers know how to evaluate the factors related to heterogeneity, they will theoretically be able to make the decision regarding the appropriate basis for contract award

Furthermore, the utilization of factors of organization's considerations shows that the internal factors dampen contracting officers' and program officers' use of business judgment in developing acquisition strategy and in determining the appropriate basis for contract award.

Moreover, whereas the factor's mean is greater than 3.0 points, the means of differentiation, innovation, complexity, and integration are higher than the other means. It can be inferred that these evaluation factors of differentiation and innovation have relatively higher importance than the other factors in this research. On the other hand, whereas the factor's mean is less than 3.0 points, the means of complexity, risk sharing, innovation, and integration have higher levels than the other means. It can be inferred that these evaluation factors of complexity and risk sharing have relatively higher importance than the other factors in this research.

## **B. RECOMMENDATION**

From literature review and the model developed in Chapter III, it is found that eight criteria related to heterogeneity analysis will significantly affect the determination of the appropriate basis for contract award. It also suggests three characteristics related to

the organization's considerations that will influence the decision regarding the appropriate basis for contract award. By combining the analysis of heterogeneity and the organization's considerations, we have satisfied this statement from the Taiwan Regulations for Evaluation of the Most Advantageous Tender in article 1 paragraph 1:

Prior to conducting procurement on the basis of awarding to the most advantageous tender, an entity shall verify that the subject matter of procurement concerns heterogeneous construction work, properties, or services, and thus it is inappropriate to award a contract to the lowest tender pursuant to subparagraph 1 or 2 of paragraph 1 of Article 52 of the Act.

It is inferred that eleven factors will help determine the appropriate basis for contract award within the Taiwan procuring environment.

Whenever the specification's clarity, availability of price information, influence of resources availability, and conservativeness of coordinating officials are rated as low, and the complexity, heterogeneity, suppliers' opportunity, innovation, required integration, risk sharing, and urgency are rated as high, the Most Advantageous Tender approach for contract award is the most appropriate basis to use.

However, when the specification's clarity, availability of price information, influence of resources availability, and conservativeness of coordinating officials are rated as high, and the complexity, heterogeneity, suppliers' opportunity, innovation, required integration, risk sharing, and urgency are rated as low, the Lowest Tender approach for contract award is the most appropriate basis to use.

After eliminating the factors related to the organization's considerations, the mean of the factors in the IT services contract becomes higher and the mean of factors in the custodial services contract becomes lower. It shows that eliminating factors related to the organization's considerations makes the result of this survey more pronounced in both examples. Based on this research, it should be noted that the factors of organization's considerations result in the subduing of contracting officers' and program officers' use of business judgment in developing acquisition strategy and in determining the appropriate basis for contract award.

According to the results of this research, the contracting officers and program officers should be knowledgeable of the relatively important factors of the requirements in developing acquisition strategy. Whereas the factor's mean is greater than 3.0 points, the means of differentiation and innovation are higher than the other means. It means that these evaluation factors have relatively higher importance than the other factors in this research. On the other hand, whereas the factor's mean is less than 3.0 points, the means of complexity and risk sharing have higher levels than the other means. It means that these evaluation factors have relatively higher importance than the other factors in this research.

### **C. FURTHER RESEARCH**

In order to expand on this research, the following is recommended to provide perspective for program officers and contracting officers.

#### **1. Impact of Factors of the Organization's Considerations**

Based on this analysis, the factors of organization's considerations dampen the contracting officers' and program officers' use of business judgment in developing acquisition strategy and in determining the appropriate basis for contract award. This area should be further researched to identify the level of impact between these factors of organization's considerations and the developing of the acquisition strategy.

#### **2. Factor of Perspective in Program Officers or Contracting Officers**

According to the literature reviewed, one characteristic of organization's considerations was the perspective of program officers and contracting officers. It was found that this characteristic will affect the decision in determining the appropriate basis for contract award and in developing of acquisition strategy. This characteristic was not included in the survey and the model since it does not make any sense for the contracting officers and program officers evaluate their own subjectivity. The analysis of the perspective of the program officers or contracting officers should be further researched to identify the level of impact between this factor and the development of the acquisition strategy.

### **3. Relative Weight of Each Factor**

Based on the results of this research, it is evident that heterogeneity and the organization's considerations are important factors in determining the appropriate basis for contract award. However, it is not clear how to weigh each factor to determine their relative importance. According to the survey, each factor has its own level of relative importance. Some are relatively important than others, such as differentiation and innovation in IT services contract and the complexity and risk sharing in custodial services contract. Further research should be conducted to determine whether the relative importance of these evaluation factors should be given more weight in the model to determine the appropriate basis for contract award and to develop the acquisition strategy.

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